ENGINEERING NEWS

THE first of the great yacht races has been sailed, with the same result as we predicted, a victory for the *Volunteer*, although neither we nor probably anyone expected such a sweeping victory. The result as we have elsewhere noted, is undoubtedly due to much the same reasons as the victory of the *Kearsarge* over the *Alabama*, as explained by one of the officers of the latter, that the *Kearsarge* "was a better ship better manned, with better guns better handled." The extent of the victory, however, was beyond question due in part to good fortune. Therefore, while the first race leaves no room for doubt that with the given weather and course the *Volunteer* was the better boat, it does leave a clear possibility that the *Thistle* may prove to be the better boat in what has heretofore been supposed to be her poorest chance, in heavy weather and a rough open sea. But while this is possible it will appear anything but probable to those who watched the first race. Mr. EDWARD BURGESS' fame as the greatest of yacht designers is now secure if he never does anything more, and we congratulate him heartily on the grand results of his genius.

THE gain of the *Volunteer* was made almost wholly in the first quarter of the course, as will appear from the following record of its lead at various points, corrected for the difference of 1 m. 52½ sec. in starting time, but paying no attention to the 5 second allowance to the *Thistle*:

Lead of *Volunteer* at Buoy 10	17 m. 34¼ sec.
" " " " Sandy Hook Lightship	20 m. 55¼ sec.
Lead of *Volunteer* at finish	19 m. 28¾ sec.

Of the 17½ minutes first lost it would probably be safe to say that 10 minutes or more was legitimate loss, and that 5 to 7 minutes may have been due to difference in wind. The gain of 3½ minutes in the second stretch was under as nearly equal conditions as well could be. In the run home before the wind the *Thistle* had an advantage more than equal to its gain of 1 m. 26½ sec., beyond question, from being entirely free from all obstruction by the enormous attendant fleet, and from getting a stronger wind, because of being 20 minutes later over the course, thus neutralizing, in a measure, the similar advantage gained at the start by the *Volunteer*.

YOUNG engineers who are citizens of New York and are in search of positions will note with pleasure the advertisement of an "open competitive examination" under the New York Civil Service rules which appears on our first page. We wish that all our States, and all our prominent corporations would adopt the same just and sensible system of filling their ranks, although we regret to see the restriction of the examination to "citizens of the State who have been residents for at least one year." Such a restriction will do less practical harm in New York State than in most others, because of its size and the number of engineers within it, but it is wrong in principle, and contrary to sound civil service ideas, when pushed beyond the only reasonable limit of "*Other things being equal* preference will be given to residents of the State." The pay which the selected young men will receive is not largess but return for value received. If a young man from Maine or Texas, or for that matter England or Germany, is willing and able to give better service for the money, why in the name of common sense and public honesty should he not be given a chance to do so? The underlying idea and intent in all such stipulations is that the men are to get more money or give less service than they ought, and hence that part of what they receive is plunder, to be kept within the State. Otherwise, the limitation is senseless.

THE Paris *Matin* of September 11, contains some late notes on the EIFFEL 1,000 ft. tower. It is now 60 ft. above the surface of the ground and about 220,000 lbs. of iron are in place, secured by 60,000 rivets. The report says that 200 men are engaged in erection and about 300 more on the work in the shops. Over 143,000,000 lbs., 7,150 short tons, of iron will be consumed in the erection of the tower, and over one-half of this is said to be finished at the shops ready to be put up. *Le Matin* says, that on the two piers nearest the Seine the vertical pressure is 3,330 French tons, distributed over a surface 90 m. square; this amounts to a load of nearly 3,000 lbs. per sq. ft. The load on the other foundations is not quite so great. The two anchor-bolts in each pier, referred to in a late number of this journal, are each 25.6 ft. long and 4 in. in diameter. M. EIFFEL hopes that sometime in January of next year the first stage of the tower, 229.6 ft. high, will be completed.

ACCORDING to Mr. W. H. PREECE, who lately read a paper before the Society of Arts on "Fifty Year's Progress in Telegraphy": "In London alone we have 255 miles of pipe, containing 10,212 miles of wire. In fact, all our great trunk lines are out of danger of stoppage from storms. We have 868 miles of open wire included within the metropolitan area, but these are chiefly in the suburbs, and include long, outlying sections, used either for police or fire-brigade wires or for private persons. There are 213 offices in London now served wholly by buried wires." It appears that in 1886 there were in the United Kingdom 26,425 miles of overhead telegraph lines, embracing 150,590 miles of wire, and 677 miles of underground lines, with 19,605 miles of wire. It is estimated that to connect only the more important towns by underground wires, and "uniting those towns by less than half the existing number of overhead wires, would cost something like £2,500,000." Of submarine cable there are now 112,673 nautical miles, which has absorbed a capital of £37,000,000. The larger part of this, or 102,531 miles, is owned by 27 private companies, having from 1 to 53 cables each.

THE London *Times* notes "a new and terrible," "perfectly diabolical" explosive lately experimented upon by the Russian Minister of War. It bids fair to outdo the qualities of melinite, roburite, etc., and is called *sleetover*. The *Times* correspondent says it is equal in strength to pyroxyline and "has the immense advantage of being ten times cheaper than ordinary villainous saltpetre," and the further immeasurable superiority "that when fired its force does not strike downward, but *entirely in a forward direction*," so that "it can be used without any damage whatever to the weapon from which it is discharged," and it is stated, in fact, that "ball cartridges loaded with it have been fired out of card board barrels as a test without the least injury to the latter." The composition of this diabolical explosive is a "deep secret." We have a very pronounced suspicion that the Russian correspondent of the *Times* has been sadly gulled, and as he gives no directions for picking out the "business end" of the *sleetover* we would advise our readers to be careful in their experiments; else lamentable results might follow from getting the cartridge in the "paper-barrel" wrong-side up.

WM. S. TOZER, one of the two State Inspectors of Bridges for Ohio, has just reported on the Cincinnati, Wheeling & New York R. R., a road 19 miles long, and according to the Columbus *Dispatch*, he finds as follows:—24 trestles or bridges that for nearly the entire distance were framed for a narrow gauge track, and now have the present broad gauge rails in all cases outside of the stringers; the ties on these bridges and trestles are 6×8 ins. and unevenly spaced; one trestle, 500 ft. long, is too frail for present loads and its entire rebuilding is recommended; repairs and renewals are neglected and only two men "look after" the whole track. Four miles are laid with fairly good 50-lb. rail, but the next 8 miles have a 30-lb. rail completely worn out, with gaps of 3 and 5 ins. bridged over by the fish-plates; some joints have no fish-plates at all and others only a part of one. Ties are rotten and spaced 3, 4 and 5 ft. apart. This is a very bad exhibit and besides being a sad relic of the late narrow gauge craze, calls loudly for very speedy action on the part of the Ohio R. R. Commissioners. It should be fenced-in and whitewashed at once, before any serious harm is done to those who are yet reckless enough to risk their lives in patronizing it.

THE following bridge accidents occurred Sept. 13: At Augusta, Ga., a canal bridge on the Port Royal & Western Carolina R. R. was destroyed by a derailed truck striking the abutment and knocking it down. Several freight cars were thrown into the canal but no lives were lost. The loss to the railroad company is stated to be from $15,000 to 20,000.—At Centropolis, Kan., a bridge over a creek broke down under a road scraper drawn by 6 horses. Six men were injured, one of them fatally.

At New Orleans, La., the equinoctial gale caused considerable damage, and several parts of the city were flooded. A serious break occurred in the Carondelet canal and the surrounding country was inundated.——A cyclone, accompanied by heavy rain, passed over Brownsville, Tex., September 21, and did serious damage to property. The village of Santa Cruz, opposite Brownsville, was submerged for several hours. The floods spread over the entire district.

THE worst accident of the week, or certainly the most inexcusable one, was the derailment on a trestle of the Mobile & Ohio Railroad near Jackson, Tenn., Sept. 27, resulting from the breaking of a truck *and* the absence of a proper floor system and re-railing guards. The train was moving fast, but the trestle was not very high, so that although some 30 people were injured and the cars and trestle badly broken up, no one was killed. This class of accident continually occurs, and yet the easy remedy for them in better floors continues to be neglected, consequently, as soon as a derailed wheel strikes such a structure disaster is certain.

THE other serious railroad accidents of the week were a collision, Sept. 25, at Holden, Mo., on the Missouri Pacific R. R. An east bound excursion train was turned onto a side track by an open switch and collided with a freight train. Two men were killed.——At Elida, near Lima, O., on the Pittsburg, Fort Wayne & Chicago R. R., a collision occurred, Sept. 22, between two express trains. One train was making for a switch to let the other pass but could not reach it in time. The air brakes on the through train, which was the east-bound Pullman vestibule train, refused to operate. No lives were lost.——On the Philadelphia & Reading R. R., Sept. 27, an open draw over Chester creek, Chester, Pa., caused the locomotive and tender of a freight train to fall into the creek. The train was running out of time and the engineer had no orders to look out for it.

THE Cairo bridge, now being built over the Ohio river for the Illinois Central Railroad, is to have the following spans:

2	518.5 ft.	each, center to center of piers.
7	400 "	" " " " "
3	250 "	" " " " "

Total length, 4,670 ft.

The approaches will be wooden trestle to be filled with earth by train after the bridge is open for traffic.

The clearance line of the superstructure is 55 ft. above extreme high water. High water mark is 52.17 ft. above extreme low water. The foundations in the river will be at least 75 ft. below low water, so that the total height of piers will be about 180 ft.

The foundations in the river will be sunk by the plenum pneumatic process. The caisson will be surmounted by a crib filled with concrete, and the total height of the caisson and crib will be 50 ft. The masonry will be built of stone from Bedford, Ind., except the up-stream nose stone, between high and low water, which will be of granite. The superstructure will be entirely of steel except pedestal castings and some unimportant parts. The plans are now prepared in detail, and the work is well under way.

The entire work will be completed by the close of 1889, about 2½ years from the date of commencing the work. The entire cost is not expected to exceed $2,500,000. The bridge is single track.

The plans have been made by and the work is under the charge of Messrs. MORISON & CORTHELL, with Mr. ALFRED NOBLE, as Resident Engineer.

The Union Bridge Co., of New York, have the contract for nearly all the work on the main bridge.

A good deal of misinformation, in regard to the structure, conflicting in part with the above, has been floating around through the press, and has even found admission to these columns, but the information here given is correct.

H. M. S. *Trafalgar*, which is to be launched at Portsmouth, England, this month, will be in thickness and weight of armor, the most powerful ironclad afloat. The dimensions are: length, 345 ft. breadth, 73 ft.; displacement, 11,940 tons; indicated horse-power, 12,000; draught, 27½ ft. The armor-belt at the water-line is 20 ins. thick and 230 ft. long, combining at the ends with 14-in. armored bulkheads. The deck is covered with 3 in. steel. The armor is backed with from 18 to 20 ins. of teakwood and this lined inside with a skin of 2 in. steel plate. The plates are compound, that is, they have wrought-iron backs with a steel face. The *Trafalgar* cost $4,600,000.

MR. GEORGE F. DEACON, Engineer of the New Water Supply for Liverpool, in his last report says that it will probably be possible to commence to impound the waters of the Vyrnwy in the winter of 1888-89, and that it can be utilized almost at once, provided the question of compensation water to the Severn is settled upon before then. The great dam at Vyrnwy will be finished in about one year. The area of the lake formed will be 1,121 acres, it being 4¾ miles long and having a maximum depth of 84 ft. With a storage capacity 50 ft. in depth, this reservoir will supply the Liverpool aqueduct with 40,000,000 galls. per day in the driest season, after providing for the Severn compensation three times the present minimum flow of the four streams intercepted. The rainfall on this watershed is very heavy; 49.73 in. being the lowest for many years, and 118.51 in. having been recorded in one year.

A TEST of the Waldumar Electro-Magnetic brake is now being made near Cincinnati, Ohio, which is well. The way in which it is being made, however, is very peculiar. The proprietors addressed a letter to the new Ohio Railroad Commissioner pointing out the dangers of travel by rail, etc., etc., at some length, and requesting the Commissioner to order tests. The Commissioner responded favorably, saying that he would appoint Maj. L. M. HOSEA, "Attorney," to conduct the tests, and requesting him, by a separate letter, to secure a good attendance of railroad men, with the complimentary addendum he "knew of no one who is more thoroughly versed in mechanical appliances," and the very extraordinary addendum that "upon reflection" he thought the matter "of such importance to the State that the State will be justified in paying the expenses." It would be well for the Commissioner to "reflect" a little longer as to the propriety of testing private devices of unproved merit at public expense, and also as to whether an "attorney," which we take to mean a patent solicitor, is likely to be in fact, "most thoroughly versed in mechanical appliances" of this nature in a practical sense. We do not prejudge the results of the tests, but the manner of making them is clearly improper.

IN a paper on "Dredging the Clyde Estuary," read by Mr. C. A. STEVENSON before the English Institute of Mechanical Engineers, the author describes a chain-bucket dredger, 164 ft. long, 30 ft. wide and 10 ft. deep, with engines of 350 H. P. The buckets are of two kinds, one holding 7 cu. ft. for use in hard material and others of 20 cu. ft. capacity for soft stuff: the first are discharged at the rate of 10 per minute, the latter 15 per minute. The backs of the buckets are cast steel, the mouths are of steel, 13 in. wide and 1¼ in. thick at the peak. The bottoms are made of steel plate with the bucket somewhat conical in shape; the pitch of the bucket-chain is 36 in. The ladder is 83 ft. long, made of two plate girders 5 ft. deep at the center and 2 ft. at the ends. With the angle of the ladder at 45° the lips of the buckets are 41 ft. below water level. The three hopper barges are each 153½ ft. long, 26 ft. wide and 13 ft. deep and the hopper is 65 × 20 × 9 ft. with a capacity of 11,000 cu. ft., or 523 tons of dredged material. During one year of work in soft stuff, this dredger removed 408,895 cu. yds. at the rate of 212 cu. yds. per engine per hour and at a cost of 5.08 cents per cu. yd. including repairs, etc., and interest and depreciation at 10 per cent. Conveying and depositing the stuff in Loch Long, 7 miles distant, cost 4.04 cts. per cu. yd., the total cost of dredging and removal being thus 10.02 cts. per cu. yd. In clay and sand the work for many consecutive days was 3500 tons per day of 10 hours.

A High Service Motor.*

BY F. H. PARKER, C. E.

The City of Burlington, Vermont, is built upon a side-hill, sloping towards the west towards Lake Champlain, from which its water supply is pumped. The reservoir is located 289 ft. above the lake, upon the crest of this hill, but not upon its summit. Two lines of 10-in. pipes lead away from the pumps to the reservoir, and connect with the general system of mains at all intersecting streets, so that we pump into and distribute from the same mains.

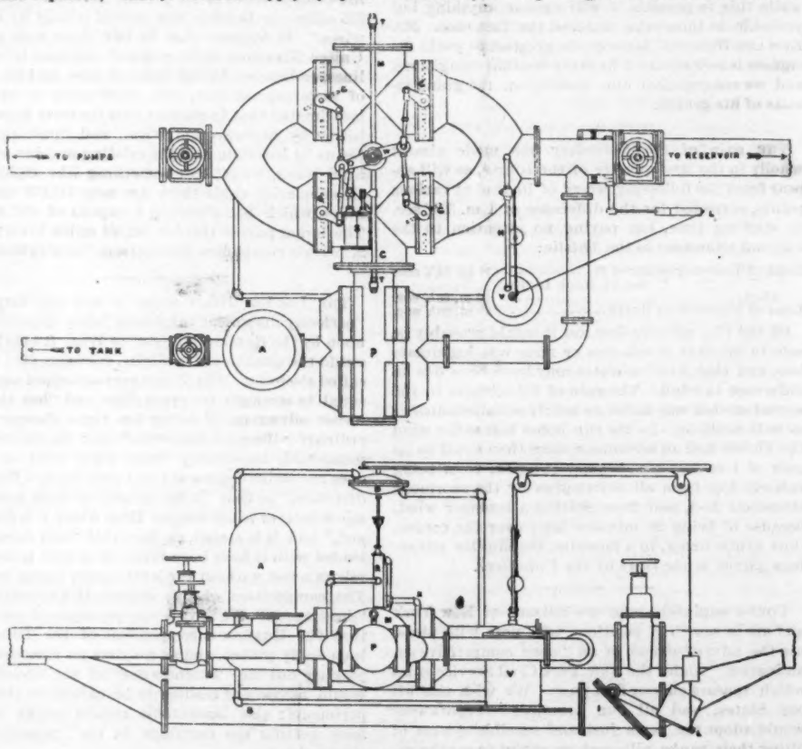
In 1868, when the works were built, there were very few residences upon the summit of the hill, but in 1879 their number had so increased, and several public institutions having been erected, the necessity for a high service water supply was conceded, and the matter was referred to the Superintendent, A. TORREY, C. E., for investigation and report. Mr. TORREY reported, "that to obtain a supply by operating pumps at the reservoir, wind power was too unreliable, steam power too expensive, and to raise the water consumed by the city 60 to 80 ft. higher, by means of the pumps at the lake, seemed to call for so large an outlay and yearly expense, as to be classed among the last resources: but suggested that some sort of a hydraulic motor might be placed in the 10-in. main in the reservoir lot; that would be worked by the water passing to and from the reservoir, and thus furnish the power for working a pump to supply the high service."

On taking charge of the water works, in the summer of 1880, this report was referred to the writer, with the request that the above plan he carried out at once. The necessary pipe was purchased, a contract was made for a tank, but where to obtain a motor to work under the conditions imposed, was a question. The conditions were as follows, the pressure of water to work a motor in that position would vary from 2½ to 5 lbs. per sq. in., while the pressure against the pump, with a full tank, would be 36 lbs. per sq. in. The motor would be in the line of main pipe, and must work with very slight friction, and without shock; it must operate by water passing to or from the reservoir; it must offer no resistance, in either direction, to a supply of water, of the full capacity of the main, at all times when needed; it must waste no water; and must be practically automatic in its action.

So far as could be learned, nothing of the kind was in use in this country. Correspondence with English engineers afforded the information that a similar use of water from a reservoir was made in Brighton, but the motor used was similar in construction to a direct acting piston pump, and worked under a pressure of 40 to 50 lbs.

The motor which was adopted, a description of which is now presented to you, was designed and built by W. H. LANG, a builder of pumps in our city, under the guarantee that if it did not satisfactorily perform its duty there should be no charge.

The cylinder to the motor, marked *M. C.* on plan, is 18 in. in diameter, 64 in. long. It is located in the line of 10-in. pipe leading into the reservoir, and connected with it on each side by 12-in. Y branches, which are still farther enlarged near the gates, *G*. Within this cylinder, working in a brass bushing, is a hollow air tight piston, 15 in. in diameter and 32 in. long, which is acted upon and makes a 30 in. stroke moved by water passing to or from the reservoir.



A High Service Motor.

To the end, *C*, of the motor cylinder is attached a plain piston pump, marked *P*, the cylinder of which is 10 in. in diameter and 40 in. long, and within which works a piston 4½ in. in diameter, making the same stroke as the motor, being connected to one end of the piston rod of the motor, which passes through cup leather packing in the head *C*. The suction valves are on the right of the pump; the discharge valves, on the left.

The supply of water to the motor cylinder is controlled by four circular brass gates, 12 in. in diameter, marked *G*, that turn like butterfly valves, on vertical stems of phosphor bronze, working in stuffing boxes and operated by the wrist plate *W*. The motion of the wrist plate is obtained by the action of a 4-in. piston in the shifting cylinder *S*, that is driven by water from the higher service. The valves that control the motion of this piston are moved by the rod *T T*, which is connected at each end with tappets, that work through stuffing boxes through each cylinder head, and are driven out first at one end then at the other, as they are struck by the motor piston as it completes its stroke.

The motor as shown in plan is working by water from the pumps, the piston moving towards the end *C* of the cylinder, and driven by water entering the upper left hand gate *G*, the water in front of the piston passing to the reservoir by the lower right hand gate. As soon as the piston reaches the end of its stroke at *C*, it drives out the tappet at that end of the cylinder; this reverses the valves of the

* A paper read at the Sixth Annual Convention of the New England Water-Works Association. From the Society's Journal.

shifting cylinder *S*, forces out its piston, which moves the four gates by the wrist plate *W*. Water will then enter the motor cylinder by the lower left hand gate, and leave by the upper right hand gate; the motor piston will move towards *M*, drive out the tappet at that end, which will, by the aid of the piston of the shifting cylinder, set the gates as shown, and the motion will be repeated.

If the motor when worked by the pumps should stop from anything getting into it, or from any part breaking, the water would pass to the reservoir by the by-pass under the motor, by raising the inclined check valve *I*, and without appreciably raising the pressure.

When the pumps are idle, and the motor is working from water passing from the reservoir to the city, the action of the gates requires reversing. This is effected by aid of the diaphragm *D*, and reversing cylinder *R* shown in elevation, but purposely omitted on the plan. The supply of water to operate the piston and valves of the shifting cylinder *S*, is taken through the reversing cylinder *R*, through a pipe *E* from the high service side of pump, and discharged after throwing the gates, through the pipe *X*, into the pipe on the low service side of the pump. The position of the piston in the small reversing cylinder *R*, determines at which port the water leaves this cylinder, and the piston is moved by being attached to a rubber diaphragm *D*, which is raised or depressed, by the pressure exerted upon it through the connecting pipes shown.

When the motor is worked by the pumps the pressure upon that side is the greater, and the diaphragm is depressed; as soon as the pumps stop the pressure becomes greater on the reservoir side, and the diaphragm is raised; this raises the piston in the reversing cylinder, and what was the supply pipe to the shifting cylinder becomes the exhaust, and what was the exhaust becomes the supply. The action of the gates is thus reversed, and the motor starts working again, by the water leaving the reservoir.

When a greater supply of water is demanded from the reservoir, than can pass through the motor, it is obtained by aid of the vacuum cylinder *V*. This cylinder is fitted with a piston, whose normal position is at the top of the cylinder; a rod connecting with it passes out through a stuffing box, and is connected by a small chain with the lever *L* of the check valve *I*. A pipe *B* connects the bottom of this cylinder, with the main pipe below the motor, while the pipe *H* connects the top of the cylinder, with the main above the motor. In the pipe *H* is a stop-cock the weighted lever to which is supported by a piece of copper wire, that forms the bottom of a small stirrup, that hangs by the side of the piston rod of the vacuum cylinder *V*, and a bolt in this rod rests on top of the weighted lever. Any failure of supply is obviated in this way, as soon as the demand exceeds the supply, a partial vacuum occurs below the motor, and a suction is created through the pipe *B*, which pulls down on the piston of the cylinder *V*; as soon as the piston begins to move down, it shears the copper wire holding up the lever to the stop-cock in pipe *H*, which allows the lever to drop, opening the stop-cock, and letting in a stream of water upon the top of the piston to assist the vacuum below. This makes the downward movement of the piston surer, steadier and faster, and draws on the chain attached to the lever *L*, which opens wide the inclined check *I*, and holds it open until the attendant closes it and allows the motor to start again.

The pump worked by this motor delivers water through nearly a mile of pipe, to a tank of 100,000 gallons capacity, and a 4-in. overflow pipe returns from the top of the tank, to the main pipe, between the motor and reservoir, so that no water is wasted, even if the tank overflows.

The motor, when working at its maximum speed, will pass theoretically, in 24 hours, 715,000 gallons, and the pump at the same time will deliver theoretically 50,000 gallons, in addition to what is used in the shifting cylinder. The actual quantity delivered is considerably less, for no such amount of water passes through the motor in that time, as our average pumping last year was only 622,000 gallons per day, and a large part of this amount was used before reaching the reservoir. We arrange our hours of pumping at different seasons, so as to only work the motor sufficiently to keep the tank full.

This motor is presented to your attention simply as a machine embodying in its construction an exceedingly ingenious and novel application of well-known mechanical principles, that has for six years, under very trying conditions, successfully, economically and almost automatically accomplished its work.

DISCUSSION.

Mr. FULLER.—I would ask what the average power of the piston is.

Mr. PARKER.—I cannot give you any exact information in regard to that. We never have made any tests. The motor has always done its work perfectly satisfactorily; it has furnished an ample supply and we have never made any tests to find out accurately what it would do. Of course there is a certain amount of slip by these gates. The gates have no exact seat. They turn, as I say, like a pivotal valve, and of course, while they are being reversed the current of water is changed, first, from the gate on the right to the gate on the left, and there is a certain point where all four of the gates are open at the same time. That is for a very short interval of time, but a certain amount of water must pass. As near as I can figure, the amount of water that is consumed on the entire service will not vary far from an average of 15,000 gallons per day. In the summer time it is greater than that, but in the winter, possibly, it is some less.

Mr. FITZGERALD.—Did you state the cost of this machine?

Mr. PARKER.—No, I did not; the cost was $1,900 and forty odd cents.

Mr. FITZGERALD.—What is the pressure on the receiving end?

Mr. PARKER.—When the reservoir is full, the head is between 12 and 13 ft., and the pressure is slightly over 5 lbs. Of course, when the pumps are not working, it absorbs a corresponding amount of pressure.

Mr. FITZGERALD.—How much higher does it lift the water?

Mr. PARKER.—The back pressure is 37 lbs., and will raise it 60 ft. I stated that the water is delivered from a tank through something over a mile of pipe.

Mr. FITZGERALD.—How much attention does this motor require?

Mr. PARKER.—When it was first put in we gave it but very little attention, just looked at it occasionally; but I have now made arrangements with a machinist to look after it and keep it in repair, and we pay him $300 a year. He takes the motor and pump apart twice a year, cleans the suction valves and takes out the accumulations that may take place there, and keeps it in thorough repair. He has a sounder connected with his house, so that morning, noon and night, when he is at home, he gets the stroke and can tell whether or not the motor is running all right. He has got it down so fine he can tell simply by listening to the stroke, so it is not necessary for him to visit it more than once in two or three days.

Mr. FITZGERALD.—How many services are there on this?

Mr. PARKER.—I think about 60. There is another point about this motor. If it was working on a line which was supplying the reservoir by gravity, where it would have a regular stroke to make, a certain amount of water passing through every twenty-four hours, you can see it would work much more satisfactory, or, at least, there would probably be much less wear and it would not require so much attention.

Now, through the night with the pumps not working, it will make, perhaps, five or six strokes a minute, and then in the day time, with the varied consumption we have, it will be running, say, twenty-two strokes a minute. It has to regulate itself to all these changes, and, of course, it gives it a much more severe test than it would have if it were on a direct pumping main, or if it were served by a gravity supply.

Mr. FITZGERALD.—It seems to me that this device is applicable to a great many water-works where the supply is comparatively small and where there are a few houses situated above the ordinary level of the reservoir. I have seen such devices on the other side of the water, but I never have heard of one here.

Mr. RICHARDS.—I would like to ask Mr. PARKER if he has ever made any experiments as to the pressure?

Mr. PARKER.—Yes, we have a pressure gauge connected with the motor, with connections both above and below. The pressure varies from 2¼ to 5 lbs., according as the reservoir is full or down. When the pumps are working, it will add that amount of pressure to the mains throughout the city. The pressure varies 10 lbs., according as the pumps are working or the motor is working when the pumps are not. In talking with Mr. LANG, who designed this motor, he said that if the pressure had been great enough to work it, it would have simplified the construction very much But the pressure was not great enough to throw the valves. If he could have had 40 or 50 lbs. pressure, he could then have thrown his gates by direct pressure and none of this shifting device for throwing them would have been required. But here the pressure was so slight it would not throw the gates quick enough, and, consequently, he had to resort to the pressure from the higher service, with the arrangement for shifting.

The Utilisation of Fire-damp in Mines.

M. HILT, director of the Society of Coal workers of Wurm, and M. A. SIMON, Engineer of the Lievin mines, have sent a communication to the Society of Mineral Industry relating to the collection and utilisation of the inflammable gases found in coal mines.

M. HILT proposes to collect the gas and use it in the steam generators on the surface or for other useful application. Experiments made at the Wurm mines show the following somewhat important results:—

There are two essentials in this utilization scheme (1) The precise determination of the time necessary for the diffusion of the gas in the atmospheric air. At Wurm it was found that when a certain amount of gas entered at the bottom of a gallery, it ascended to the top in a certain time and remained there a long time without mixing with atmospheric air. The diffusion of the gas in a proportion of one-tenth required 3 to 4 hours for this admixture, owing to the sluggish air circulation in the gallery.

(2). At the Westphalia mines it has been determined that the gas escaping comes almost entirely from the freshly broken coal or coal recently uncovered. And that this escape is in the first few hours, and ceases after some days, The greatest quantity of gas is then found in galleries being worked and at the working face, while galleries worked out give little gas. These observations have been confirmed by the experience of 1885 at the mines of Gouley and Gemeinschaft.

The plant required to collect and use the gas includes a system of piping leading to all the working faces and uniting in a principal main passing to the surface, and there connected with a powerful exhaust. At the Koenig mine the air compressors were transformed into exhausting machines with the following results:

From a portion of the mine producing about 100 tons per day and worked by 100 men, from 0.6 to 0.8 cu. m, of gas were extracted per minute, forming with the air a mixture of air, 92 to 94 per cent., gas, 8 to 6 per cent.

The section was well ventilated and received from 200 to 220 cu. m. of air per minute. It is certain that in one part of this working a mixture of 10 per cent. of gas was extracted; a mixture not only combustible but even explosive. This mixture, if not utilized under the boilers, could have been put to useful work in a gas-motor, as the mixture was precisely correct for that purpose.

M. A. SIMON said that this process depends upon the feeble velocity of the air in the gallery which would permit the atmospheric air to be enriched by the escaping gas. The more complete this diffusion the better the gas product. But this principle is in absolute opposition with the theory of energetic mine ventilation and there is a risk, by imperfect diffusion, of creating a dangerous gas zone in the top of the gallery.

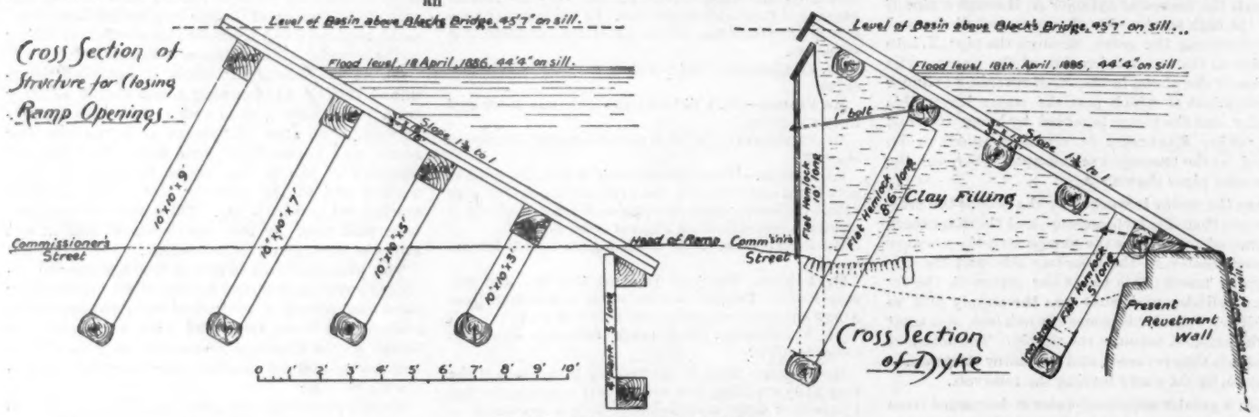
M. MINARY, a long time ago, proposed a system of gas collection very similar to that of M. HILT. His idea was to put in the bottoms of the galleries a series of trenches containing zinc tubes, which would conduct the gas by a principal main to the surface. But this plan was never extended beyond the theoretical stage. But it should be said for M. HILT that he has been guided by actual experiment and while little yet has been actually accomplished a way has been opened that may lead to useful results.

Le Genie Civil.

WE are pleased to see that the illustrated comic journals are lending their powerful aid in favor of an early solution of the car-coupler problem, if it can be called such any longer. The *Judge* gives up its main cartoon on Sept. 17 to a picture of an alleged meeting of railway presidents in which an imaginary resolution was adopted approving the action of the Master Car Builders' Association for "the abandonment of the deadly link and pin." As the car-builders themselves have not yet formally voted on this matter by letter-ballot, the announcement is a little premature, but we have no doubt the prophesy will come true in substance if not in form. The ballots so far received indicate, we are told, the adoption of the late Convention's action by at least the necessary two-thirds.

The New Montreal Flood Dykes.

The St. Lawrence river is one of the most even in its flow of all the large rivers in the world, owing to the equalizing effect of the vast storage reservoirs known as the Great Lakes, the average variation during a year being only 10 to 20 in., but it is also the most subject to ice of all the large rivers within the limits of civilization, because of its northerly location. After the ice has once set, or "taken," as the technical term is, no disturbance results therefrom, but in the spring when the ice is breaking up, and likewise in the early winter when it is forming, but is not yet set for the winter, very dangerous and objectionable floods result in Montreal, and at other less important points upon the river. The highest flood on record in Montreal was a spring flood in 1886, shown on the accompanying cut, but four of them of a dangerous character have occurred within two years, after an interval of seven or eight years without any floods of moment.


Level of Basin above Black's Bridge, 45'7" on sill.
Cross Section of Structure for Closing Ramp Openings.
Flood level, 18 April, 1886, 44'4" on sill.
Slope 1 to 1
Commissioner's Street
Head of Ramp
10'x10'x9'
10'x10'x7'
10'x10'x5'
10'x10'x3'
0 1' 2' 3' 4' 5' 6' 7' 8' 9' 10'
Level of Basin above Black's Bridge, 45'7" on sill.
Flood level 18th April, 1886, 44'4" on sill.
1" bolt
Flat Hemlock 10' long
Flat Hemlock 8'6" long
Clay Filling
Slope 1 to 1
Flat Hemlock 5' long
Present Revetment Wall
Cross Section of Dyke

The New Montreal Flood Dykes.

To meet the dangers resulting from these floods the river front of Montreal was many years ago (about 1832-3) laid out in a peculiar way. The river front is occupied first by a rather narrow street about 10 ft. above the ordinary stage of the river, and then by a higher street known as Commissioners' street at a level some 10 ft. higher, faced by a handsome cut stone retaining or revetment wall, the top of which appears in our engravings. These walls were at the time supposed to be above all probable high water, and are fine specimens of first class masonry, except that the stones are rather small, being of the gray limestone quarried near the city, which is almost the only building material used in Montreal for all kinds of buildings. They extend from the mouth of the Lachine canal, the lowest of the four canals by which the St. Lawrence rapids are overcome, for a distance of nearly 1¼ miles down the river. They are connected with the lower quay or river front by occasional ramps or steep (too steep) inclines parallel with the wall and river, up which loaded teams have the greatest difficulty in ascending.

The whole work is a very handsome one, and considering its early date of construction a highly creditable one to Montreal, but although the walls are laid out according to what is still established practice for retaining walls, and although no part of the walls have fallen, yet they have been gradually thrown over by frost, each year a little more, until there are long stretches which are on the point of overturning, having lost all their original batter of 2 ins. per ft. and begun to overhang. They have also been sliding forward on their beds so that each course overlaps the other.

From both causes together, most of the wall is in bad shape, while there is hardly any of the original wall which stands wholly uninjured.

The structural history of these walls is an instructive lesson in retaining wall practice, which we shall give more fully later, with illustrations. Whether the walls are in good or bad condition matters little now, as it is plain they must come down, either to be replaced by higher walls on the present locality or to be moved out to the river's edge and made very high walls indeed, the latter more heroic project having many friends, as the large steamers, which constitute the bulk of Montreal's shipping would be better served by high piers.

In the mean time, the structure which we illustrate has been adopted as a temporary expedient to keep out the high water and to last a few years, until definite projects for permanent works can be more carefully prepared. Whenever the flood rises above the top of the retaining wall, shown in the cuts, several hundred cellars are flooded, and experience indicates that this may happen six or eight times a decade. Whenever the water rises a few feet higher, the loss is very great indeed.

The dyke proper is constructed as shown in our second engraving, being anchored by stout iron straps to the revetment wall to prevent disturbance by ice. At points where the ramps occur, gaps are left in the dyke, which are left open during the summer season and closed during the winter only by the temporary structure shown in our first cut, and the upper part of this structure also is left open an d for most of the winter to give wagon and sleigh communication with the river, there being a great deal of travel over the ice at that season.

This temporary dyke extends along the whole river front below the Lachine canal, there being about 5,600 ft. in all, its total cost being some $50,000. Above the canal there is nearly two miles of earth levee, extending up to a connection with the tail-race of the water-works, which itself constitutes a dam. This earth levee is built 10 ft. on top, with 1½ to 1 side-slopes on each side, the average center height being 7 to 17 ft., which would be entirely inadequate proportions, except that it will have to resist water in the winter season only, when it is likely to be frozen solid.

All these works are under the control of the Montreal Harbor Commissioners, of which Mr. JOHN KENNEDY, M. Am. Soc. C. E., is Chief Engineer. The same Commission are carrying on constantly very extensive dredging operations, which are likewise deserving of fuller description than we can now attempt.

The Superstructure for the St. Lawrence Bridge.*

The St. Lawrence bridge was first outlined, about five years ago, by Mr. PETERSON of the Atlantic & Northwest Railway Co., but it was not until November of 1885 that the contract for the Superstructure was awarded to the Dominion Bridge Co., of Montreal, with Mr. C. SHALER SMITH as Consulting Engineer, and Mr. P. ALEX. PETERSON as Chief Engineer for the Railway Company. The designer of the bridge was the late Mr. C. SHALER SMITH; Mr. FRANK D. MOORE, as Chief Assistant Engineer, having full charge of the calculations and the details.

In adopting the lengths for the different spans at the selected crossing of the St. Lawrence river, there was no precedent to guide the designer, excepting the lengths which had been adopted for the Victoria Bridge, which are as follows:—24 spans each 240 ft. center to center of piers, with one channel span of 350 ft. center to center of piers. In the St. Lawrence bridge we have 8 spans of 240 ft. center to center of piers, 2 spans of 269 ft. center to center of piers, and 2 channel spans of 408 ft. center to center of piers.

The St. Lawrence bridge begins properly at the first crossing of the Grand Trunk Railway, which is by an 80 ft. through girder. The next crossing is the canal, which is a swing bridge 340 ft. long. The general design of this swing bridge is of the triangular pattern, known in Mr. SMITH'S office as the "Menomonee" type. This swing has a rim-bearing table turning on 34 wheels, which are placed on a circular track and operated by hand power or steam power from the center. There are two classes of draw-spans, rim-bearing and center-bearing, the center-bearing being used for spans of short lengths up to 150 ft.; for spans of longer lengths, it is customary to use the rim-bearing, or the rim-bearing and the center-bearing combined, it being easier to operate the rim-bearing swing for longer lengths. The first span of this pattern (the triangular) was designed by Mr. G. H. PEGRAM, M. Am. Soc. C. E., formerly assistant to C. SHALER SMITH, for the Chicago, Milwaukee & St. Paul Ry. The advantages in this form of swing are in having low inclined chords at the ends, which aid in deflecting a possible derailed car which might strike the bridge, and which also reduce the area exposed to wind pressure at the ends of the arms, making it easier to handle during high winds. The supposed advantage in avoiding all counter strains in this form of bridge, which Mr. PEGRAM had at first supposed to be the case, is not true. One particular feature in this span are the rocker links at the center, which tend to equalize the pressure on the turntable, making the strains on the center posts at all times alike in any one pair. The ends of the arms, when the draw span is closed, rest on the crowns of inclined beds, which are set at a proper elevation to give the reactions necessary for a beam continuous over three level supports.

The heights at the ends are determined by calculation, and ample margin is made for any discrepancies in these heights due to unequal expansions from temperature, lack of uniformity in the elasticity of the material, or any imperfections in the workmanship.

After crossing the canal, we come to the river spans proper, which consist, first, of three 80 ft. deck plate girders, then the eight 240 ft. deck spans.

It might be stated in regard to the plate girders used in the St. Lawrence bridge, that they are all provided with rockers at the end supports, so as to allow any vertical movement in the girders themselves due to deflection from passing loads, or to neutralize any imperfections in the workmanship which would tend to bring any undue pressure on the bed plates or expansion rollers.

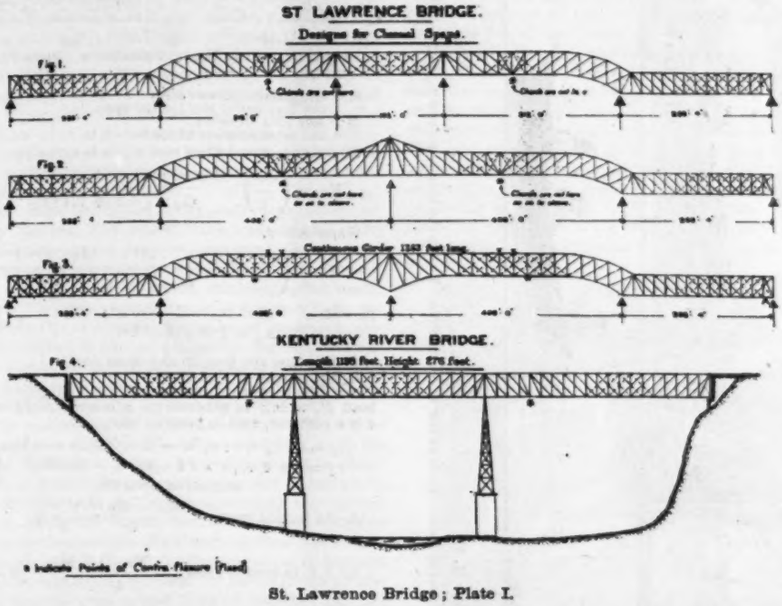
This has been Mr. SMITH'S late practice for all girders above 50 ft., and was first used for the Denver & Rio Grande Railway in 1884.

The general design of the deck spans is the double intersection Pratt truss.

The two systems are entirely independent of each other throughout. Where the diagonals cross the vertical posts, there is a pin running through the post, making the ties in two lengths. It is a matter of regret that this practice has been used so indiscriminately by the engineers in the States, without any regard to its pernicious effects. This has been

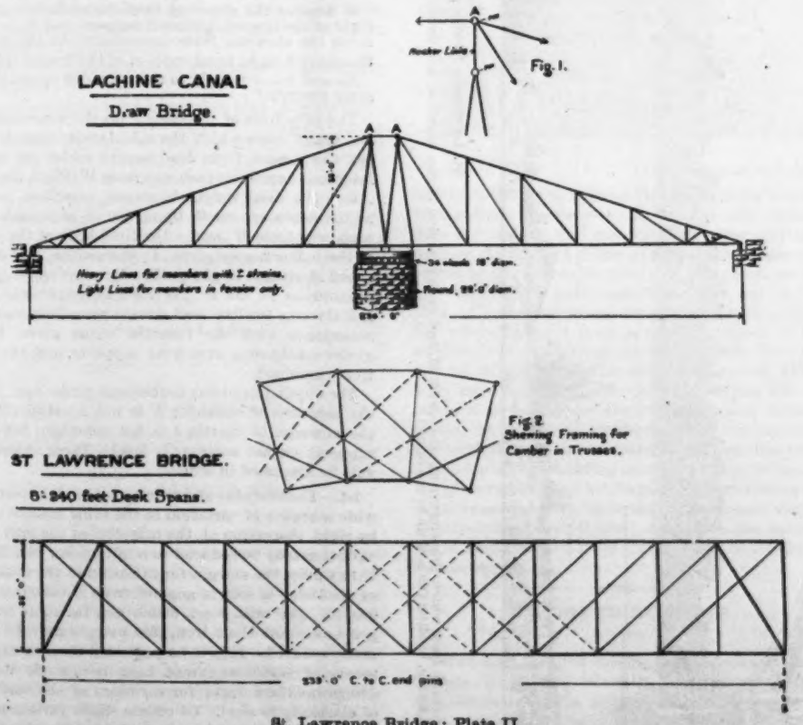
* A paper by J. W. SCHAUB, M. Am. Soc. C. E., read before the Canadian Society of Civil Engineers.

the case, for example, in such large structures as the Plattsmouth bridge, in which there are posts 50 ft. long on centers, divided into half lengths by the ties crossing at their middle, without any provision for the effects of distortion due to strain in the members; the effect of a load coming on a structure framed in this manner can be easily shown (see



St. Lawrence Bridge; Plate I.

Plate II.) Supposing the trusses to be cambered when there is no strain in any member, the intersection of the tie is at some point below the center of the post. Now, when the load comes on the span, the chords tend to become horizontal, the posts tend to become vertical, bringing the intersection of the ties with the posts more and more towards the center of the post, until finally, when the entire camber is taken out of the truss, the intersection must necessarily be at the center of the post; the amount of this movement depends on the length of the panels and the depth of the truss. In the 240 ft. spans of the St. Lawrence bridge, this movement amounts to about ¼-in. and has been provided for by making the holes in the posts 1-in. larger than the pin, thus allowing ample movement for the pin when the load comes on the bridge. This movement can be noticed in a structure at any time where the pin is free to move, as in the St. Lawrence bridge. Where the pin is not free to move, the distortions must necessarily take place in the members themselves; and, moreover, this practice is questionable where it has been done with a view to figure the posts for half their total length, and consider them as fixed ended where they are held by the diagonals at the center.



St. Lawrence Bridge; Plate II.

The next portion of the bridge to be considered are the two 209 ft. spans and two 408 ft. spans, forming four continuous spans over five supports. There were two designs proposed besides the one that was finally adopted (see Plate I.) The design as adopted was known in Mr. SMITH's office as the "Flying Cantilever," and was first proposed for the Storm King bridge over the Hudson river, in the State of New York. As used in the St. Lawrence bridge it is, properly speaking, no cantilever bridge, as the spans are continuous. The cantilever principle is used here for erecting the bridge only, which is built out from the piers on each side, the ends being joined at the center when the final coupling is made and the spans become continuous over five supports. The advantages of the cantilever principle are only in saving in the erection, there being no saving in the weight, as there is merely a different distribution of the material from what there would be in ordinary disconnected spans. In a continuous girder there is necessarily a saving in the weight over the piers, as was the case in the St. Lawrence bridge, but the saving in the mode of the erection is the principal item to be considered here. The advantage of using two center piers instead of one would have been a considerable saving in the cost of erection, but not sufficient to counterbalance the increased cost of the extra masonry; this was the principal reason why one centre pier was only used instead of two, as shown in Fig. ——.

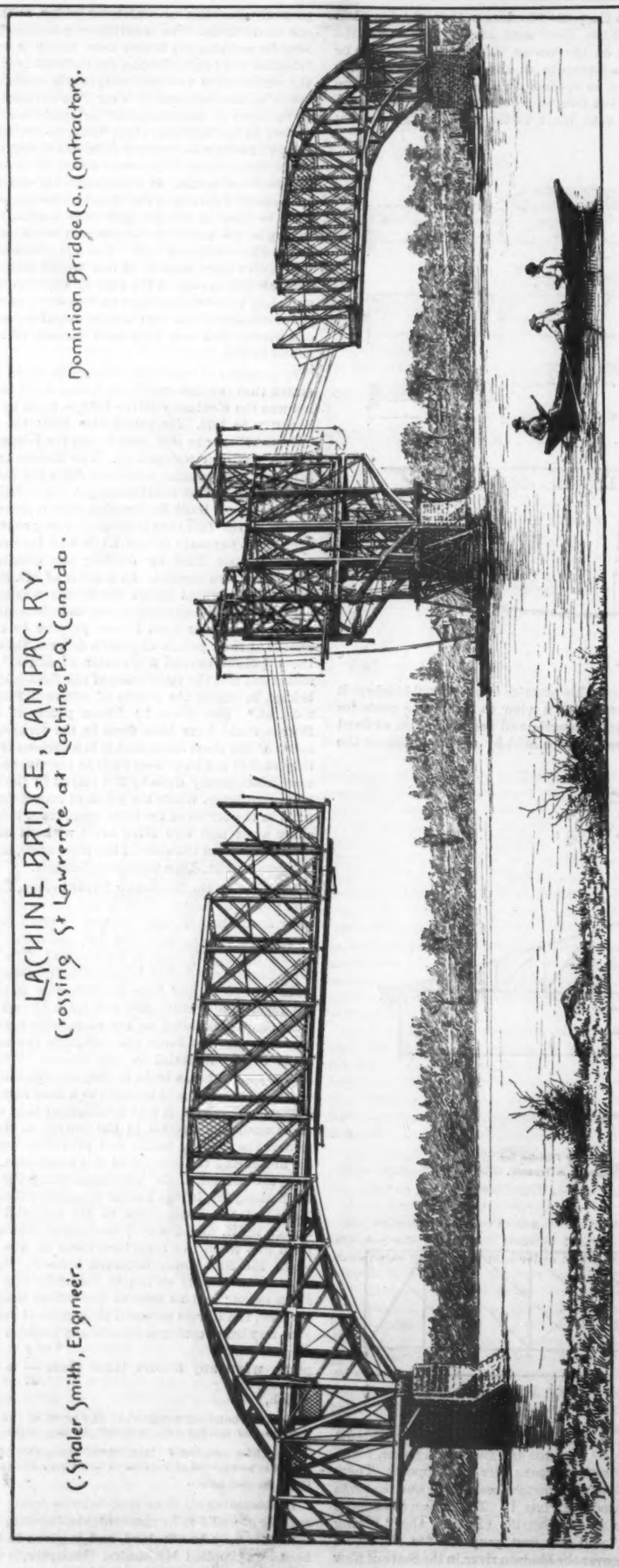
In speaking of cantilever bridges, it might be here stated that the first cantilever bridge built in America was the Kentucky River bridge, built by Mr. C. S. SMITH in 1876. Mr. SMITH also built the Minnehaha cantilever in 1881, long before the Niagara cantilever was ever thought of. The Kentucky River bridge is a wonderful structure, from the fact that it is really the first continuous pin connected girder that was ever built in America, and is remarkable also from the fact that instead of being continuous over four supports (Plate I.) it had its points of contra-flexure fixed by cutting the chords after the bridge was erected. In a letter of Mr. SMITH's, written two years before the bridge was built, he says: "I feel so confident of my calculations of the continuous girder that I now propose to cut the chords at their points of contra-flexure, thus fixing these points beyond a question of doubt." This statement was the forerunner of the Kentucky River bridge, in which the points of contra-flexure were fixed at.* (See Plate I.) These points of contra-flexure could have been fixed in the river arms instead of the shore arms, and it is a curious fact that they should not have been fixed in the river arms, as was subsequently done by Mr. SMITH in the Minnehaha cantilever, where the point of contra-flexure is fixed in the center of the river span, there being two shore arms and two river arms without any mid span hung from the ends of the river arms, as in the Niagara and St. John cantilever bridges.

In regard to the Kentucky River bridge, the question might be asked: How is the expansion of the river span—that is, that portion of the bridge between the towers—provided for, inasmuch as the trusses are rigidly fixed to the towers? The towers must necessarily deflect longitudinally when expansions take place, and here the deflection in the towers from temperature, and also from the effect of a train of cars skidding on the rails, with brakes set, has been provided for in proportioning the sectional areas of the material in the towers. When the bridge was tested, a train of freight cars, moving at 40 miles per hour, was brought to a dead stop on the bridge. Of course it was anticipated that a movement would be noticed in the towers, in the direction of the moving train; and provision was made for measuring the amount of this movement. However, the friction of the wheels skidding the whole train along the bridge had no apparent effect on the inertia of the large mass of the material in the bridge itself, and the only movement that was noticed was when the train first came on the bridge when the first tower deflected towards the train coming on simply owing to the deflection of the shore spans; and as soon as the entire bridge was covered, the towers resumed their normal positions.

In any beam continuous over any number of supports, when any flexure takes place $\frac{I}{R} = \frac{M}{E\,I}$ in which,

M, is the bending moment at any point in the beam.
R, is the radius of curvature of the beam at that point.
E, is the modulus of elasticity of the material.
I, is the moment of inertia of the cross section of the beam at that point.

By assuming all the supports to be level; and assuming E and I to be constant, the theorem of three moments may be obtained, and is given in all text books on Applied Mechanics. However, it was not until September, 1875, that Prof. MANSFIELD MERRI-

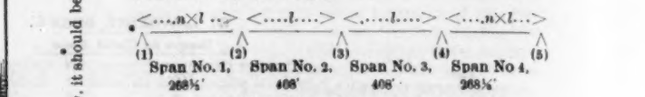

LACHINE BRIDGE, CAN. PAC. RY.
Crossing St Lawrence at Lachine, P.Q. Canada.
C. Shaler Smith, Engineer.
Dominion Bridge Co., Contractors.

St. Lawrence Bridge; Canadian Pacific R. R.

[NOTE.—The photograph from which this engraving was prepared, had been reversed in the negative, and the error was not discovered until the drawing was complete. To see the bridge correctly, it should be looked at through the paper from the back side, holding the leaf up to the light.]

MAN gave, in the London *Philosphical Magazine*, the formulæ for a beam continuous over any number of level supports, which are at all practicable. These formulæ are as follows:

Formulæ for obtaining pier moments and reactions, as applied to the four continuous spans in the St. Lawrence bridge:—



m = the number of any pier.
r = the number of any loaded span.
M = any pier moment.
s = the total number of spans = 4.

The pier moment when $m < r + 1$, is given by

$$M_m = \left(\frac{Cm}{l}\right) \times \frac{A\,c_{s-r+2} + A_1\,c_{s-r+1}}{C_{s-1} + 2(n+1)C_s}$$

When $m > r$,

$$M_m = \left(\frac{c_{s-m\times 2}}{l}\right) \times \frac{A c_r + A_1 c_{r+1}}{c_{s-1} + 2(n+1)c_s}$$

in which
$$\left.\begin{aligned} A &= P\,l^2{}_r\,(2k - 3k^2 + k^3) \\ A_1 &= P\,l^2\,r\,(k - k^3) \end{aligned}\right\}; \quad k = \frac{a}{l_r}.$$

P denoting the load in any span, and
l_r, the length of that span.
a = distance from nearest left hand support to the load P, which is necessarily a concentrated load; c is a number, and in present case,

$c_1 = 0$: $c_2 = 1$: $c_3 = -(2 + 2n) = -3.3154$.
$c_4 = 4 + 3 + [n \times (4 + 4)] = +12.2616$.

SHEARING FORCES.

$$S_r \text{ (in loaded span)} = \frac{M_r - M_{r+1}}{l_r} + q$$

$$S_{r+1} \text{ (in loaded span)} = \frac{M_{r+1} - M_r}{l_r} + q_1.$$

$$S_m \text{ (in unloaded spans)} = \frac{M_m - M_{m+1}}{l_m}.$$

$$S_{m+1} \text{ (in unloaded spans)} = \frac{M_m - M_{m-1}}{l_{m-1}}.$$

in which $q = P(1-k)$; $q_1 = P \times k$.

S_r denotes the shearing force immediately to the right of the nearest left hand support, and S_{r+1} denotes the shearing force immediately to the left of the nearest right hand support of the loaded span.

S_m and S_{m+1} apply to the unloaded spans in the same manner.*

The principles of the design for the four continuous spans, upon which the calculations were based, are the strains from dead weight which are calculated as a cantilever each way from W (Fig. 3, Plate I.) After the dead weight is swung complete, proper adjustments are made by means of adjustible ties each way from W, and adjustible beds at the ends of the balancing spans at A; the section XY of top chord is riveted in place when the four spans act as continuous as far as live load is concerned. The calculations for live load strains were then made in accordance with the formulæ before given for a girder continuous over level supports, and the two were combined.

The objections to any continuous girder are: 1st—the modulus of elasticity E is not constant; 2nd—the moment of inertia I is not constant; 3rd—the supports are not necessarily level. These objections will be discussed in order.

1st.—The modulus of elasticity, as is well known, has wide margins of variation in the same material, but by rigid inspection of the material at the mill this variation may be reduced to a minimum. Mr. BOUSCAREN gives the margin for variation of the modulus of elasticity of iron in general from 23,000,000 to 28,000,000. For mild steel, which is a far more homogeneous metal than iron, this margin may be very much reduced. It is to be regretted than no experiments, of sufficient extent, have been made with a determine the margin for variation of the modulus of elasticity in steel. Of course slight variations in the percentage of carbon in steel produces wide margins in its ductility, but a rigid inspection at the mill can guard against this. In the St. Lawrence bridge great care was taken in securing a mild uniform steel with an ultimate strength of about 60,000 lbs. and a ductility of 18 per cent. in 12 diameters. The tests subsequently made on some of the full-

* The above formulæ are given by DUBOIS in the "Strains in Framed Structures," page 135, but unfortunately the signs + and − should be reversed.

sized members at Pittsburg, Penn., showed the material to be the same as when tested in small specimens. The material was found to be all that could be desired, and the Steel Company of Scotland deserve great praise in furnishing a uniform steel, a material not easily obtainable. Their mode of manufacture is the Siemens open hearth process.

2nd.—The moments of inertia in the formulæ are assumed constant, and give results which are entirely on the safe side, the stresses being greater than they actually would be, especially over the piers.

3rd.—The supports which may be assumed to be out of level can be at any time adjusted by means of the adjustable beds at the ends of the balancing spans at *A* (Fig. 3), and any inaccuracy in the distribution of dead weight can be at any time noticed in the variation of the strains in the ties at the center of the channel spans at *W*.

The three objections to the continuous girder are very serious, and would have undoubtedly been sufficiently strong to have prevented the use of a continuous girder for these spans, had it not been for the conditions under which this design was made. A consideration of these will at once show that the problem for closing the two channel spans was certainly solved in the most scientific manner, when it is borne in mind that the positions of the piers were all fixed, and it was considered unadvisable to use false-work in raising the two channel spans.

The trusses for the continuous girders, it will be noticed, are of the double intersection type, as in the eight 240 ft. deck spans. A question might be raised as to the possibility of making correct calculations of the strains in the curved portions of the channel spans, inasmuch as the two systems here combine their strains one into the other. It would be impossible to do so if the calculations were made for each system separately, but here the calculations for the two systems were carried through together, and the work was very much simplified by using the graphical methods entirely, for calculating the strains in the continuous girders for the St. Lawrence bridge. As to the methods used in the calculations, Mr. MOORE, of St. Louis, has recently prepared a lithograph, which shows all the essentials necessary to understand the methods used in a very concise form, consequently here full details as regards the calculations will be omitted.

The unit stresses used in the details are essentially as follows:

Steel @ 12,000 lbs. per square inch for tension.
Iron @ 8,000 " " " " "

The only tension members that are iron are counter rods and the wind bracing. For the wind bracing a higher unit stress was used. The compression members were all figured by the "Rankine-Bouscaren" formulæ, which are certainly the best formulæ in use, as they give results which agree more nearly with the results obtained from actual tests than any other formulæ. As used in the St. Lawrence bridge the formulæ for steel are:—

$$P = \frac{10000}{1 + \frac{l_x}{36000 \times r^2}}$$ for fixed ends.

$$P = \frac{10000}{1 + \frac{l^2}{24000 \times r^2}}$$ for 1 fixed end and 1 pin end.

$$P = \frac{10000}{1 + \frac{l^2}{18000 \times r^2}}$$ for two pin ends.

These formulæ are so well known that no explanation is necessary. The 10000 lbs. for steel in the numerator is substituted for 8000 lbs. for iron, as given by Mr. BOUSCAREN in his report to the Board of Trustees of the Cincinnati Southern Ry. As the matter of guard-rails in railway bridges has now become so very important, it would perhaps be well to say that when the St. Lawrence bridge is completed, a train of cars could be run off the track for the entire length of the bridge, without the passengers being aware of it. The ties are spaced with 4 in. openings, and the wheels are guarded by two heavy guard rails on each side of the track.

The only accident that could possibly happen to a train of cars on this bridge is, that they might be blown bodily off the track, provided a western cyclone should happen to visit this section of the country, which is not at all probable.

(TO BE CONTINUED.)

The Heading of the Hudson River Tunnel.

In our issue of July 23 we described, with drawings, the centering used in the Hudson River tunnel. We have also described from time to time the method of building the tunnel. This week we present an engraving of the heading from a photograph taken with the aid of a magnesium light. The picture shows about one-third of the section of the tunnel in height and nearly the full width.

The track extending through the work is laid on top of the pilot, the position of which may be judged from the braces supporting the plates and which radiate from it. The most noticeable feature about the centering is the small amount of space occupied. The four iron ribs take no more room than is absolutely necessary, and as they are entirely self-supporting, no extra timbering is used. With the centering in, the work is, in reality, more roomy since the radial braces are then removed as rapidly as possible. The platforms for the masons are carried up with the walls, and in no case is the central passage-way obstructed. It will be remembered that the ends of the ribs rest upon longitudinal timbers placed next to the walls and which are supported by transverse beams whose outer ends are let into the masonry and whose inner ends rest on the pilot. Upon these beams are placed planks so that the whole forms a floor across the tunnel at the level of the track. Upon one side of this floor the cement is mixed, the trough being moved ahead with each section, to save carrying. Upon the opposite side, bricks are dumped and spare timbers stored. At no stage of the work do the masons interfere with the men in the heading, so that the work of advancing the heading or excavating, putting up the plates and laying bricks goes on simultaneously. It is the endeavor to have the advance section completely ironed and cleaned out when the masons finish keying up, in order that their work can go on uninterruptedly.

Centering in Heading of Hudson River Tunnel

ENGINEERING NEWS.

THE headings of the Kansas City tunnel, for which Messrs. R. P. MCCORMICK & Co., are contractors, met on Sept. 29, the progress of the work having been much more rapid than was expected. The material was somewhat treacherous.

IN a recent test of the Ward flexible joint it was found that a 6-in. pipe would stand a pull of 145,000 lbs., or nearly 73 tons, before the lead stripped out. The test was made to determine how long a stretch could be left hanging above the bottom in laying, with the evident result that it could be a pretty long stretch.

THE recent tests of the Sprague electric motor in this city were not so favorable in result as to inspire much confidence that they have solved the problem of electric transit, if we are correctly informed as to the details of the trial. A second test is to be made shortly, however, and it is extremely probable that they or some one will solve the problem of electric street motors actuated by storage batteries, which offers so many obvious advantages.

THE French Railway Company, on the line running from Tunis to the Algerian frontier, are utilizing the ground along the road by planting the *Eucalyptus resinifera*, or red gum tree. Some 300,000 have already been set out at a cost of about $100 per acre with 1600 trees to this area. It is estimated that of this number 600 trees will survive at the end of 20 years and be then worth $2 each. The *Acacia cyanophylla* is also planted as it yields a bark rich in tannin. The worst enemies of these forests are the goats.

THE rate of immigration is falling off, the increase over corresponding periods of last year having been

Month of August, only	10.6 per cent.
Two months ending August	18.0 " "
Eight months ending August	42.4 " "

The only countries showing a marked increase are Great Britain and Sweden. The others barely hold their own or have fallen off.

It is a most hopeful sign that immigration has begun to fall off in this way before a crash has come to make it necessary. It leaves ground for hope that the crash may be escaped.

AS England will not defray the cost of making a survey for a telegraph cable from British Columbia to Australia, Mr. SANFORD FLEMING now suggests the Colonies interested do it at their own expense. The matter is to be discussed by the Canadian Council and if this body is favorable the Australian Colonies will be communicated with.

THE board of engineers appointed for this purpose have valued the locks and dams on the Monongahela river at $1,950,000, but the owners want $4,000,000 for their property. The engineers find that while a little over $3,000,000 have been expended upon them in construction and repairs, nearly $6,000,000 have been collected in tolls. Hence the disinclination to sell at Government figures. If the State extinguish the franchise and the federal government purchase them, they can not be delivered until 1909. Condemnation in the public interest is the only speedy and certain remedy.

IT is claimed that the railway now building across the Andes to connect Buenos Ayres and Valparaiso will shorten the journey between England and Australia fully two weeks.

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GEO. H. FROST, - - - BUSINESS MANAGER.

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THE accounts of the New York press have been defective in several particulars in respect to the first of the great yacht races, in part perhaps because those yachtsmen whose opinions would have been likely to be correct and command confidence were unwilling to entrust them to the tender mercies of the daily papers.

Speaking not only from our own knowledge and close observation but with the concurrence of those whose judgment in such matters "cries at the top of ours" the real facts in regard to the race seem to be these:

There were three factors in the *Volunteer's* first victory: a faster boat, better seamanship and better luck, the last in great degree the consequence of the second. The *Volunteer* was skillful enough to cross the line in a somewhat better position, and with somewhat better headway than the *Thistle* (contrary to the expectation of those who observed its comparatively logy movements in preparing for the start) and being somewhat faster in addition was rapidly drawing up upon the *Thistle*, with great probability of blanketing her, although the rising wind was so fickle and variable that there was no great certainty of this. To avoid the danger, and the mortifying probability (or rather certainty) that the *Volunteer* would pass her almost immediately, and in the vague hope of catching a better breeze, the *Thistle* tacked across the *Volunteer's* bows and almost immediately came about again on the same course as before. This extra tack, which the *Volunteer* did not make at all, of course threw it far in the rear, and in a sense was an error of judgment, but its actuating motive beyond all question was less to gain an advantage than to avoid too early confession of disadvantage. It necessarily took away most of the *Thistle's* headway, which was a serious matter in so light a wind, and to this, rather than to the difference in wind (which probably also existed), must be ascribed the very rapid gain of the *Volunteer* during the next half hour.

As if this were not enough, the *Thistle* made two other entirely needless tacks in rounding buoy 10 and buoy 8½, (at each of which there was an angle of some 45° in the course) both of which it might have easily avoided by standing on its previous course a little longer. The immense attendant fleet may have obstructed its view, but there were not one-third as many boats about to do so, since most of them had gone ahead with the *Volunteer*. As for wash and blanketing by excursion boats, its evils have been greatly exaggerated as respects both boats, but the *Volunteer* unquestionably suffered the most, being the leading boat. For more than three-quarters of the whole course the *Thistle* was in the rear of the three hundred or more sails on the ground, and had the whole ocean to itself, as well as a slightly fresher breeze, while the *Volunteer* was more or less impeded. But probably neither boat lost half a minute by it, or anything like it.

The second race in the open ocean will be measurably free from these embarrassing questions of buoys and handling, by which the *Thistle* lost so much in this race, and may the best boat win. There is nothing in this race to prove that she may not, the difference in time being much greater than the model alone can explain.

THE most hotly contested election ever held in the city of Nashville, Tenn., occurred September 22, on the proposition that Davidson county subscribe $500,000 to the stock of the Tennessee Midland Railroad Company, a corporation which proposes to build a line from Memphis to southwestern Virginia, and has now 135 miles under construction from Memphis east.

The campaign throughout was marked by a profuse use by the promoters of the tax of personal calumny and blatant demagogism of a most disgraceful character. We do not know whether this was due directly to the Tennessee Midland officers or to the editorial staff of the Nashville *American*, but whoever authorized or used it is deserving of unreserved censure. Their attacks were directed against the officials and owners of the Louisville & Nashville Railroad, who we are aware replied to some extent, we do not know how much, in the same strain. In so far as they were guilty of this, and in so far as the charges made against them were founded on fact, they deserve a like censure. But as the Midland faction seem to have been the greater sinners in this regard their defeat must be regarded as fortunate, and if they continue to employ the same tactics, we may reasonably hope and expect that they will meet a second defeat when the subsidy is again submitted to the voters, as we understand is to be done next month. The justice or injustice of the proposed subsidy, is a separate question. Our objection is to the use of the methods of the ward politician to such an unprecedented extent as was done in this case.

GEN. GRANVILLE M. DODGE, one time Chief Engineer of the Union Pacific R. R., testified last week before the Committee now investigating some of the eccentricities of Pacific railroad builders, that the 1032 miles of that road cost $50,000,000, or nearly $50,000 per mile. The General explained this excessive cost by the statement that certain sections called for unusual outlay. The Wahsatch mountains, *e. g.*, were crossed in the winter "when the snow was on a level with the tops of the telegraph poles, and the men were compelled to dig down through the snow and blast the frozen ground." He also saw "track laid by men standing up to their shoulders in water," and "stretches of track laid that winter on ground icy and frozen as solid as adamant, and watched the track, the locomotive, cars and all else slide away in the snowdrifts beyond recovery." These little stories are at the same time tall and deep, and we give them for what they are worth. It is possible that they used very short telegraph poles on that line, and the General may have been more successful in his requisition for particularly long-armed spike-drivers than was that lieutenant of "Swamp Angel" fame who asked Brig. Gen. E. W. SERRELL, C. E., for a detail of "100 men 150 ft. high to wade through a swamp 120 ft. deep."

THE article on city traffic, which appears in another column, is of interest enough in itself, but will be read with special interest in connection with some diagrams and other statistical matter relating to the same general subject which we shall present very shortly, relating chiefly to the intra-mural traffic of New York, Brooklyn and London, which show some very curious and interesting facts. It would conduce greatly to the wise laying-out of rapid-transit facilities if the facts of the past were more studied as an indication of the future, and we therefore commend this matter to general attention.

HAD it been the purpose of those concerned to make the block system ridiculous it could hardly have been done more effectually than by its suspension during a crowd of travel which caused the Doncaster accident of which we give fuller details elsewhere. The very purpose of that system is to guard against the danger of a great number of trains and of the occasional variations of routine which will occur, and through which alone accidents usually happen. The very time when both the number of trains and deviations from routine were greatest was chosen as the time to set aside the blocks, and let trains run more closely upon each other! The more rational alternative of having one or two intermediate block stations for use in very crowded seasons had evidently not commended itself to the authorities, who chose instead the obviously unsafe plan of putting on a line of green men (for that work) with red flags. Whether these flagmen forgot to perform duly an unaccustomed duty or the enginemen failed to look for an unusual signal is an unimportant detail. Very possibly it was both. The train which was surrendering its tickets was standing on a siding with a switch open behind it, or no collision would have occurred at all.

A PROJECT, having much in its favor, has recently been started in Virginia to build a fine drive-way or boulevard between Washington and Mt. Vernon, which should become in time a sort of monument to peace and unity and an imposing tribute to the Father of his Country by statuary and other appropriate construction as time and means might permit. The land owners along the line have already pledged themselves to give the right of way free, for a width of 20 ft. with few exceptions, and it is proposed to raise the capital for completing the work by organizing a corporation with 1,000,000 or more shares at $1 each, to be taken by public subscription throughout the country.

The distance is about twelve miles only, and the present roads are very bad, so that they are little used. Directly on the line of the proposed boulevard is a stone archway built by Washington himself, before the Revolution, and still in perfect preservation. There would probably be no great difficulty in placing almost any number of $1 shares if the project were otherwise placed on a solid foundation, and it should make one of the most beautiful drives in the world, and be a grand and appropriate monument to the memory of Washington; provided, always, the designs were entrusted to skilled landscape architects, like OLMSTEAD & VAUX, and not to inexperienced hands.

WE are gratified to observe in a circular issued by Prof. R. THURSTON with reference to expert services this golden sentence, which we wish could be lived up to by all professional men who are called in court as experts:

"I should in all cases prefer to respond to the interrogatories of the court, with approval of both sides, rather than serve either litigant alone."

We fear the halcyon days will not soon come in which this will be the rule and not the exception, but the rule should be lived up to by every one that in all such matters it is dishonorable to show bias, or to feel it,

except as one is always biased in favor of the truth, on whichever side it lies.

THE last issue of *Herapath's Railway Jouanal* contains on almost facing pages a review of the American and British railway finances for 1886. On the British page it is recorded that the average capitalized cost of all railways in the United Kingdom is £42,848 per mile, or some $210,000. In regard to the cost of American railways we have the following, which we suppose was intended and must be regarded as a handsome tribute to our American roads. The delusion that American railways are such noticeably "rough affairs" compared with the British, and that this explains the main part of the difference in cost, is still hung on to, but it is a pleasing novelty to find the true cause why the per cent. of operating expenses in this country is higher properly explained, as due to the low rates rather than the high expenses;

"Although American railroads are comparatively rough affairs, and although many of them have been carried through districts in which nothing was paid for land, it will, perhaps, excite some surprise when we state that the average cost of constructing and equipping each mile of American railroad stood in 1886 at £11,000 per mile in round figures. The average cost has been, however, rather declining during the last four years, having been $54,301 in 1886, as compared with $55,059 in 1885, $55,329 in 1884, and $55,461 in 1883, showing that the considerable extent of new railroad constructed during the last two or three years has been built at a comparatively cheap rate. The ratio of the working expenses to the traffic receipts upon American lines averaged last year 67.84 per cent., as compared with 65.12 per cent. in 1885, 65.21 per cent. in 1884, and 63.78 per cent in 1883. It will be seen that the ratio of the working expenses is higher in the United States than in Great Britain or Europe,—a fact probably explainable by the long distances run by American trains at comparatively low rates of remuneration. But for the enormous relative amount of work obtained by American railroad men out of each train and each engine, American lines could scarcely be worked at all. But those must be difficulties, indeed, with which American railroad managers find themselves unable to grapple. "Necessity," says the old proverb, "is the mother of invention," and the soundness of this axiom is proved day by day in every department of American enterprise and industry."

Perhaps a juster criticism would not assign so large a maternal function to necessity, but that is a small matter. She is beyond doubt a prolific mother.

The Latest Burlington Brake Tests.

The record of the very remarkable tests to show the effect of the improvements in the Westinghouse triple-valve (chiefly) which have recently been made by Mr. WESTINGHOUSE, which we noticed last week, were as follows:

Fifty Empty Car Train.

No. of Stop.	Speed.	Distance.	Grade.	Shock.
1	20½	179	Level	*None*
2	38½	586	Level	*None*
3	20	165	—53 ft.	*None*
4	40	695	—53 ft.	*None*

Twenty Empty Car Train.

No. of Stop.	Speed.	Distance.	Grade.	Shock.
1	20	111	Level	*None*
2	40	421	Level	*None*
3	20	127	—53 ft.	*None*
4	40	484	—53 ft.	*None*

The last tests, without stopping to analyze them exactly, show an efficiency of full 14 per cent. in the brakes, which verges hard on to the ultimate possible at the given speeds if the brakes acted with full force from the instant of applying brakes to the stop, and is only some 5 or 6 per cent. below the efficiency shown in Mr. WESTINGHOUSE'S experimental van of years ago, which was rigged up with an apparatus designed to gradually reduce the high initial air pressure as the speed fell, so as to eliminate the effect of the varying coefficient of friction (much lower at high speeds) and keep the friction at all times barely below the nearly constant force which suffices to skid the wheels. This apparatus has been adjudged too complicated for general use, and we are not aware that it has ever been attempted to apply it to a train, perhaps unfortunately for the public. Any leakage of air which there may be during a stop will have the same effect, however, and it would seem as if a little judicious negligence in making very tight fits might be highly advantageous in the same way, and might explain a part of this very remarkable efficiency. We doubt, however, if this is the case, for nothing of the kind has appeared in former tests, the pressure in the brake-cylinder remaining nearly constant to the end, after once applied.

It will probably never be possible to work up to such high efficiency in practice for any length of time, if for no other reason than that it must cost a good deal in skidded wheels to attempt it on any large scale, but the significant fact of the test is that with brakes applied, with the utmost possible suddenness, their application is so nearly simultaneous throughout the train that *shock is entirely eliminated*, and all the advantages of electrical application obtained from the air alone, without the inevitable complication resulting from the use of electricity. The importance of this result can hardly be over-estimated. The severe shocks resulting from sudden application of brakes to long trains threatened to prevent their use in freight service, unless corrected. There appeared to be no way to correct them except by simultaneous application of brakes, and no way to obtain the latter except by electricity. The objection to electricity was not simply its cost, although that would inevitably be considerable, but the constant danger that it would be out of order at the critical moment, and cause an amount of trouble that would create general dissatisfaction.

Nevertheless, until some time after the June test, there was probably no one in the United States who had given any attention to the results of preceding tests, except Mr. WESTINGHOUSE, and perhaps some of his immediate assistants, who had the least belief that it was possible to increase the quickness of application by means of reduction of pressure in a long pipe running under 50 cars, with 50 hose-couplings in its length, so as to avoid this shock. The Master Car Builders' committee reported very emphatically in favor of electricity and against the possibility of safely dispensing with it. Mr. WESTINGHOUSE, however, has continued to carry on experiments, and in a very brief time has actually accomplished this, in what seems to be an entirely satisfactory and reliable manner.

The way in which this has been done is by determining that if the pressure be reduced at the head of the pipe a *pulsation* is transmitted backward with substantially the velocity of sound, and in fact a little greater, for the same reason that very loud sounds, or ampler vibrations, are transmitted slightly faster than weaker ones. This wave or undulation of pressure loses little or none of its intensity in its motion, and the new triple-valves is so arranged as to be actuated by this first pulsation. The effect is that the brakes are applied with the velocity of sound, and this velocity is sufficient to eliminate all shock, although it does not cause exactly simultaneous application. A good part of the vast improvement made since the first series of Burlington tests has been secured by the simple expedient of somewhat enlarging the pipe, but the remainder is a triumph of mechanical skill, hardly less honorable than the original invention of the brake, and one which will no doubt tend to greatly hasten the introduction of freight train brakes.

There is but one serious impediment to the very rapid introduction of freight brakes, the link and pin coupler. So long as that is in use the advantages to be obtained from an air brake are much less, for the simple reason that a chain is only equal to the strength of its weakest link. Early in October the result of the Master Car Builders' ballot will be announced and we trust and believe it will be a decisive one in favor of the Committee report. We understand, however, that the ballots so far received do not give absolute assurance of this, many of the larger companies holding back until the last moment. Should the result finally be unfavorable it will be a serious blow, not only to the public interest but to the Master Car Builders' Association.

A Defect of the Signal Service.

A defect which should be corrected at once in the observations and outfit of our Signal Service, and which we trust only needs to be mentioned to be corrected, was pointed out in a paper by Mr. S. WHINERY, read at the last meeting of the American Society of Civil Engineers. This defect is that at only one of the several hundred Signal Service stations is there a self-registering rain gauge, nor, if we are correctly informed, are there any special arrangements or instructions for systematically gathering approximate returns of the rate of fall per hour. Consequently, although we have abundant data as to the total annual rainfall in various localities, we have no evidence as to the violence of the single storms which occur at each place. For nearly all great rain storms are preceded and followed by less violent rain or even by long-continued mere drizzle, so that even the knowledge of how much rain has fallen in a day, does not give by any means a clear index of the rate of fall.

For many of the purposes of the engineer, and some of the most important ones, the rate of fall is far more important than the total amount. For laying out water-works, the latter perhaps suffices, but for proportioning sewers or water-ways of structures, the maximum fall per hour is alone significant, and very great differences exist in it, differences which seem to be controlled by a quite different law from that which controls the total rainfall, for terrific storms occur in regions where the total rainfall is small perhaps even more frequently than where it is great. It was proposed by Mr. WHINERY, in his paper referred to, to assume for lack of better evidence, that the maximum rainfall per hour to be expected in any locality was *one-twelfth* of the annual rainfall in inches. Such an assumption has certainly no scientific basis, nor have we the least belief that it would be found to fit the facts even approximately. It would make the maximum rate from 2½ to 3½ ins. per hour in most parts of the United States, which is indeed a very high rate, and higher than the system of sewers that we know of is proportioned to carry off, but to assume 3 ins. for all localities on this continent would, we suspect, be quite as likely to hit the facts.

Nor is knowledge of the maximum rate which has ever been observed by any means sufficient. What the engineer wants to know, and often very badly, is,—How often are inch, inch and a half, two inch, etc., rainfalls likely to occur in any given locality? To answer this question properly there is needed a record extending over a good many years and giving this information for a great number of different points. It would then be possible to decide with some precision what were the probabilities at any one spot and what expense might fairly be incurred between them. It is not sufficient to have such data for any one locality, for however many years back. No law can be deduced from them with any certainty even for the point where they were taken. But with simila records for 500 miles around such a

point a very definite idea could be formed at any time.

It is obvious that such observations as these are only possible through Governmental machinery, for their value lies both in their extent and duration. Moreover, the Government has the machinery already organized and without other expense than a few thousand dollars for apparatus it can obtain every year, and embody in a separate report and maps, data which would be of the highest value as to the maximum rates of fall observed. A very little ingenuity would suffice to give quite full information in small space as to how frequently and for how long heavy rainfalls of different rates, had been observed, and in eight or ten years the engineer would have something like a positive guide from the information collected for designing works at any point in the United States, whereas he acts now almost entirely in the dark, with many washouts of sewers and structures as a consequence.

The Signal Service has shown such an earnest desire to extend its usefulness in every possible way, and such records as we have suggested would have such an obvious value to the meteorologist as well as the engineer, that we cannot but hope that this will be added to the much useful work which it now does. It would be a kindness to the local observers likewise, rather than a burden, since it would make it easier for them to "put in their time" without weariness.

Good Sense in Grand Rapids.

The authorities of Grand Rapids, Mich., have shown strong common sense in their late method of solving an important public question involving an increase in their water supply. It seems that there were a variety of available sources, and the usual diversity of opinion among citizen experts as to what was best to do. After considerable local friction it was finally decided to submit the question to three competent engineers who were to examine the whole subject independently, and unknown to each other, and to report to the committee. These experts were—J. D. COOK, of Toledo, J. F. WARD, of Jersey City and HOWARD MURPHY, of Philadelphia, all engineers experienced in hydraulic matters.

The reports were all opened at one time, and it was found that they agreed substantially as to the best source of supply, and the quality of the available water; in the quantity required, and in the fact that no dependence could be placed in any scheme looking towards a subterranean source, or water from wells. While differing in the detail of treatment, these reports agreed in the main features; and the committee was enabled to unanimously report a general scheme of extension, and to recommend that an engineer be at once set to work upon the detailed construction plans.

There are decided advantages in this composite plan of obtaining engineering advice. It is true that three expert fees had to be paid; but in return for what bears a very inconsiderable proportion to the interest at stake, the city obtained three opinions from competent men, and had the satisfaction of knowing that, in this case at least, their project has the support of the unanimous judgment of three engineers instead of one only. In other words, they have every reason to believe that they are doing the best that can be done. It is an example well worth following by other cities, both in their own interest and in that of good engineering generally.

Even if the three opinions conflict in some essential points, as might be the case, the knowledge that there are knotty points involved is worth paying for, and they can then have the question further discussed on a broader, and better understood basis. The conclusions sifted from the several reports made to the Grand Rapids authorities involved the key to the whole situation, as the question of constructive detail is very subordinate to that of source of supply, and the quality of the available waters. And in determining this very important item it is just as well to have the opinion of more than one engineer, if for no other reason than the satisfaction of feeling that the best is being done.

We do not think that engineers will object to the Grand Rapids plan as long as they receive proper compensation for their services and feel assured that their reports will be measured by their professional worth alone. There is some objection, however, to keeping the engineers in the dark as far as the services of other engineers on the same work are concerned, as the natural implication is that this is done to check collusion and a pooling of reports. The reports should be made from separate personal investigation and upon independent data, but there might be some advantage, and gain in quality, in the knowledge that a report was to be compared with other reports upon the same subject. We do not mean that any engineer would knowingly shirk the duties imposed upon him by such an examination. But there are examinations and examinations, and it is only human nature to sometimes follow the practice of a celebrated Scotch solicitor who gauged the length of his legal opinions by the number of guineas in his fee. And it is human nature again to do our utmost, regardless of fee, when we know that our judgment is to be compared with that of others engaged in a like profession. In a word, professional competition on an honest basis is often a sharper spur in such matters than even a liberal professional fee. It very generally pays to handle such an examination exhaustively, regardless of considerations of immediate compensation, and the experience of one of the engineers engaged on the Grand Rapids examination illustrates this very well. This engineer swept the field thoroughly and presented detailed plans and nine estimates of cost based upon alternative plans of construction and amount of water required. The natural result was that the committee paid most attention to his report, as it presented tangible plans and figures that could be compared and discussed. The general scheme embraced was practically the same as that presented by his fellow experts, but his pictures and his cold figures won the day, and the committee recommended that he be employed to perfect plans presented and to act as *the* engineer of the proposed work.

As far as the cities are concerned, if the authorities have the true interests of the citizens at heart, as these interests are at stake, they will see to it that all the experts engaged are men fully competent to pass judgment upon the case, and will pay them a fee commensurate with the service expected and sufficient to engage the time of men of experience. Cheap experts, in a case like this, are very liable to prove exceedingly expensive in the end. The scheme virtually amounts to submitting an important public question to a commission of engineers; but with the difference that these engineers make independent examinations and present independent reports, instead of pooling their opinions in a common report, as is usually done in such cases. The chief advantage of the plan seems to be that it relieves the city of the responsibility of selecting a single engineer whose decision is to be final and binding, and enables it to sift from several reports the conclusions which have the weight of a common authority, and have pointed out to them the items upon which the doctors may disagree. As the committee, to which such matter are usually referred, rarely has any technical knowledge of the best practice to be pursued, and is yet supposed to be responsible to the citizens for the plans adopted, this composite plan seems an excellent one for guiding them in general conclusions and for pointing out serious difficulties of conditions, if any such exist.

The Status of Naval Civil Engineers.

Civil engineers are just as essential to the well-being of the home establishment of the United States Navy, in the designing and building of new docks and yards and in the care of existing works of this nature, as is the Engineer Corps in the care of our fortifications and other public works under the charge of the War Department. It is true that our naval engineers are few in number, for the good reason that our naval establishments do not equal in extent the work that comes under the control of the War Department. But as far as they go the duties of their engineers are just as onerous and the position quite as responsible as that of the army engineers, and common justice should demand that they be equally respected.

We are induced to make these remarks by the late shameful treatment of Mr. P. C. ASSERSON, a Member of the American Society of Civil Engineers, the Civil Engineer of the Brooklyn Navy Yard and the ranking engineer among the engineers in the service of the U. S. Navy. This gentleman, of acknowledged engineering experience in his particular line of duty, was placed in charge of the Brooklyn Yard three years ago, succeeding another civil engineer, who was removed for displaying too much energy in asserting the position and dignity of his corps. Since that time Mr. ASSERSON has also had to combat the aggressive line officer in the attempt of the latter to make the engineer subordinate to him in all things technical as well as those purely administrative. So far the line officer has won, and Mr. ASSERSON, while doing all the work and shouldering all the responsibility for about the only work connected with the Yard that requires a technical training and the exhibit of brains, is not permitted to sign a single official document and finds himself in all things under the orders of an officer who is absolutely ignorant of the duties of the civil engineer. Not content with this, the further indignity has just been put upon him of depriving him of his house in the Yard, built especially for the Civil Engineer of the Yard, as this officer is required by his duties to be there from early in the morning till late in the evening. The Pay Director of the Yard, another staff officer and one whose office hours are short, has taken Mr. ASSERSON's house, and the latter gentleman is now living some three miles from the Yard to his personal inconvenience. It might be said that this house matter was a trifle after all, were it not but a further step in the attempt to utterly subordinate the engineer, not only to the line officer but to his brother staff officers.

The whole trouble lies in the unwise policy, not only in the present but in past Administrations, of putting a line officer at the head of the Bureau of Docks and Yards. This is a matter to which we have before referred and we must again have something to say. A commodore or captain is usually made chief of this bureau, not because he is at all fitted for the duties of the position, but as a reward for past services in the line of the Navy, or as a mark of special favor in the then head of the Navy Department. To this man, who would

feel insulted if he were credited with a knowledge of the duties of a staff officer, the civil engineers of the Navy must submit their plans for approval, and as against his Knickerbocker decision, they have no appeal, even were this official to follow the example of good old WOUTER VAN TWILLER and weigh the evidence presented by balancing it in his two hands, and duly award according to the avoirdupois alone.

We can imagine the nature of the reply to a colonel of an infantry regiment who should undertake to instruct an officer of high rank in the United States Engineers in his duties regarding the planning of a fortification or the rectification of a river's mouth. Yet this infantry colonel may well know more about either of these subjects than does a naval line officer concerning the design of a dry-dock or the details of the work of a naval engineer. The head of this Bureau should be the best civil engineer the Navy can afford, and the line officer be put at something he understands. The present practice is a relic of antiquity that cannot too soon be done away with, as it practically has been in England and on the Continent by nations which actually possess a navy. The duties of the office are becoming too important, even with us, to leave them in the hands of an official, who, like one bluff and honest old commodore we know of, passed plans of a dock submitted to him for official approval with the remark that they "were——pretty pictures, but what in——do I know about them?" If the engineer must assume all the responsibility and do all the work, as is the case now, it is more than unjust to deprive him, not only of official recognition, but even of the respect due to other staff officers in his department of the United States service; it is unmanly treatment, and it is pleasant to know that the majority of the unprejudiced naval officers censure the Secretary who will permit this matter to go uncorrected and allowed himself to be guided by a naval ring that seems to have control of affairs at Washington.

Secretary WHITNEY has done well in many respects, and for this good we give him all credit. Let him now pay some attention to this particular branch of the service; and as we are to have new docks and enlarged yards to meet the growing demands of our "new navy," let this work be done not only by engineers but under a competent engineering chief. What *esprit du corps* can he expect, what inducements does he offer to good engineers, under the present freezing-out system, to serve the navy with their best professional endeavors? None at all, that we can see; and nothing but the fact that all men are loath to abandon a profession in which the best part of their lives has been expended will explain the retention of good engineers in the service. The Chief of Engineers in the War Department is the most experienced officer in his own corps, and any member of that corps is eligible in time to this position of trust and responsibility. So the head of the corresponding bureau under the Navy Department should be the best man in his corps, and the line of promotion be open to all in that corps. This is only common sense and justice, backed by a true sense of what is for the best interest of the service.

THE Philadelphia *Press* publishes a long account, which has the probabilities in its favor, of an alleged unsafe wooden Howe truss bridge, 10 years old, 60 ft. high, and of unstated but short span on the Philadelphia & Newtown branch of the Reading Railroad. All trains are now ordered to slow up over it, which is in itself an indication that the bridge is unfit for its locality. A number of other wooden structures of the vicinity of alleged inferiority are also enumerated. The officers of the company, however, deny that the structures are weak.

Decimalizing England's Coinage.

Every Englishman should be congratulated upon the prospect now open to him of having his coinage at last reduced to a decimal system and of getting rid of his awkward *l. s. d.* It is hardly creditable to the most advanced nation of the earth that in regard to its unit of money it stands in line with Egypt and the Ottoman Empire alone, two nations which are generally regarded as being typical of a lack of all progressive spirit. Every other great nation of the world, and even the little kingdoms like Greece, Roumania, Tunis, etc., have long ago abandoned the mixed coinage of their predecessors and have introduced the decimal system.

The decimalization of the coinage is now accepted in England as a relief from existing conditions and as a good thing; but such a change cannot be lightly made in a great commercial nation, and the question of adjustment between the new unit and the present coinage, the postage and revenue stamps, licenses, taxes, duties, etc., must be carefully considered, and it is this question that is now being discussed.

To Americans, who a century ago adopted a decimal coinage, along with some other ideas of *La Republique Francais* that fortunately did not stick quite so well, it is interesting to note the plans proposed by Englishmen for adjusting the many difficulties presented. Some of these schemes would seem to make confusion only worse confounded in an attempt to retain in the new coinage certain values for which there is no existing coin, such as the guinea, which is only useful in making out a fee, and in a genteel and elegant manner swindling the client or patient out of so many additional shillings. The names suggested for the new coins sound very awkward, and among these we note the *aur, double-aur, argent, Imperial, Victoria, royal*, etc.

In the apparently best digested scheme which we have seen the "5-cent" piece, equivalent to a half-penny, is made the bronze unit; "50-cents" (=5*d.* = 10 cts. U. S.) is the silver unit, and an "argent" is the equal in value to 10*d.* or a French franc, or 20 cts. U. S. currency. In rendering accounts the "cent" would be the unit and £3. 6*s.* 1¼*d.* would be represented by "7,937 cents," or "79.37 argents"—the ¼ cent being dropped. While this is an improvement upon present methods we can imagine that some of the British shop keepers will be troubled for awhile with decidedly mixed accounts. But as this system retains the "penny," or rather substitutes for it "10-cents," the reduction is not so bad to figure out as some of the other schemes proposed, which would make the shilling, the florin or the farthing the unit of value. We would suggest, however, a little more democratic simplicity in naming the new coins; a "bob" is decidedly vulgar, but a short, monosyllabic word will be more popular for the unit coin than a longer term, and then let them halve it and quarter it, or double and quadruple it, as occasion may demand, and both the English cabby and the Yankee traveler will have less mental gymnastics in coming to an understanding.

CORRESPONDENCE.

The New Method of Dimensioning.

CHARLESTON, S. C. Sept. 22, 1887.

EDITOR ENGINEERING NEWS:

I desire to make a correction in your recent editorial (see ENGINEERING NEWS for Sept. 17, 1887, p. 205) on "The New Method of Dimensioning," as it is proper to have the case fairly stated.

Your editorial contains the following passage: "There appears to be a tendency amongst the new method advocated to produce a formula for allowable stresses which shall be general in its application to any part of a structure simply by modifying LAUNHARDT'S formula in such a manner as to give increased weight to live load stresses equally throughout a whole bridge, irrespective of the position of the various members, and varying merely as the span of the structure."

That "increased weight to live load stresses" *is not given* "*equally*" to all bridge members of the same bridge, was particularly emphasized on page 55 of your issue of July 23, 1887, where it was specifically mentioned that formula (1) for iron (and similarly for other materials) although giving equal weights to live load stresses on chords, and end posts for the same span, made an exception in the case of the other web members, so as to increase the percentage allowed for impact and vibration gradually, from the ends towards the center of the bridge where the allowed unit stress for ties and counters is invariably, for best bar iron, 7,500 lbs. per sq. in. no matter what the space.

In conclusion let me add that the new method is not deduced from any *theory* at all, but rests, as far as may be, on the solid facts of observation and experiment. It should, therefore, be *par excellence* PRACTICAL if the facts are only sufficient. Theoretical writers on this subject have invariably taken as a basis the theoretical law relative to the difference in effects between loads gradually and suddenly applied. This theory, unfortunately, does not cover the whole case.

Again, we have the great body of bridge engineers who arbitrarily assume certain unit stresses for certain bridge members. Of the three methods it is claimed that the first is practically more correct than the others, besides being more systematic than any empirical determinations by *any* engineer, however eminent.

In deducing formula (1) we first consider the effect on unit stress of a great number of repetitions of the loading quite suddenly applied. It is plain that we are able to do this for a bridge member, much more accurately if not quite exactly, by aid of WÖHLER'S experiments than without them; though it has been carefully pointed out that for reasons given, it is well to lean to minimum values of the coefficient of $\theta = \frac{min.\ B}{max.\ B}$. This step having been taken, it only remains to consider the influence of motion of the train on increased deflection and stresses. This is easily done as soon as sufficient observations are at hand for all spans; and it is certain that eventually these observations will be made. From such as are at hand, in connection with the LAUNHARDT formula (1) may be said to be evolved: so that it is nothing more than the embodiment of the best results of observation and experiment, modified, it is hoped, judiciously, for the bridge members to which it is intended to apply.

There is a great advantage in thus separating the effect of repetition and impact; and if the degree of suddenness of application and the rapidity of repetition could likewise be separately determined we should be advanced a long way towards the complete solution of the case. Of course *very* exceptional loads, as wind loads, must still be arbitrarily considered and present practice is endorsed in this regard; but I know that many engineers of experience (if not the great majority of them) have more difficulty in understanding, and intelligently specifying unit stresses for even ordinary loads than most subjects met with in common practice.

The "new method" involves a *reason*, based largely on experiment and observation, for every step taken, and it challenges a comparison in this regard with existing practice, and it is hoped that it will be made in a fair and impartial manner.

Respectfully, WM. CAIN.

A Sanitary Sewer.

SIOUX CITY, Ia., Sept. 21, 1887.

EDITOR ENGINEERING NEWS:

Have you, or any of your readers had any experience in carrying a sanitary sewer under a creek? In the original design for the sewerage of Sioux City, a 12-in. sanitary sewer, draining about 400 acres was carried under Perry creek, a muddy stream, with its channel 20 ft. below the banks, 75 ft. wide at the top and 30 ft. at the bottom. But few connections are made with it at present. As originally designed, it was made of vitrified clay sewer pipe, which has been changed to cast-iron, leaded at the joints. A 6-in. flushing tank in a manhole 3,000 ft. distant, and examining manholes on both sides of the creek. What are the probabilities of its being self cleaning?

SANITARY.

[We should judge its chances were better for being self-fouling than for being self-cleaning. If it belonged to the common run of sewers, and not to the sanitary class, it might be different.—ED. ENG. NEWS.]

The Late English Railway Accident.

LONDON, England, Sept. 17, 1887.

EDITOR ENGINEERING NEWS:

By this mail I send you newspapers containing account of the railway accident, yesterday, near Doncaster. It appears that during great traffic, such as that on race week, the block system is suspended, and the trains are flagged by men stationed along the line, thus replacing a reliable machine with an uncertain one.

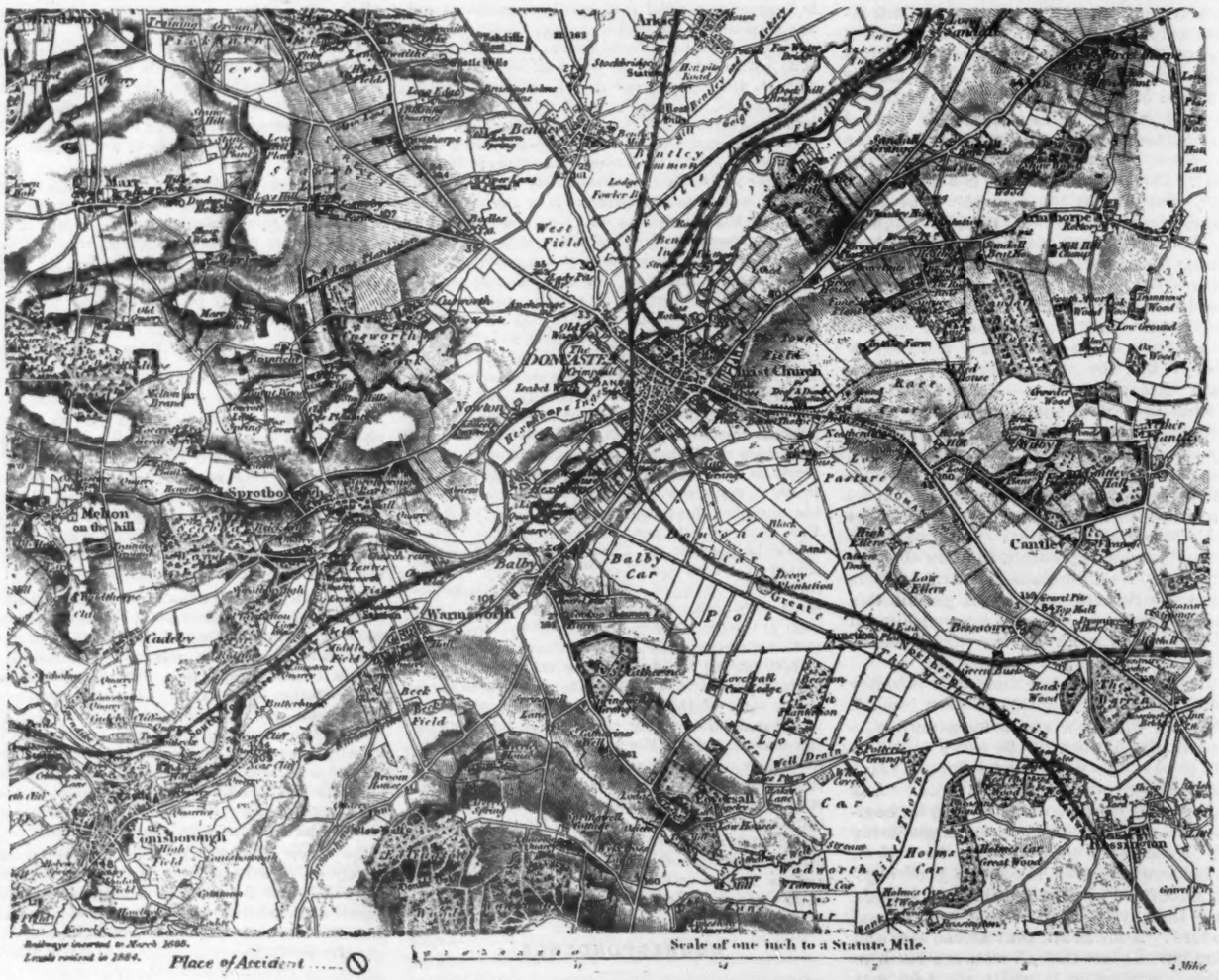
It is probable the true cause of this accident never will be known, as the engineer will swear that there was no danger signal, and the flagmen will be equally positive that there was. As in all probability there were no other witnesses the question will always remain undecided.

I also send you the latest ordnance map showing the line of railway at, and near, the place of the accident. This map shows that there was ample distance between the curve and station to stop the train, provided it was equipped with good automatic brakes in good working order. Yours truly,

EDWARD BATES DORSEY.

[More to show the beautiful style in which the whole surface of England, Scotland and Ireland has been mapped in the Ordnance survey than to make clear the simple details of this accident, we reproduce, to the same scale, a section of the map sent by Mr. DORSEY. The original sheet, which is No. 87, is 13½ x 11½ ins. The sheets are sold separately at 1s. each.

The accident appears to have been a tail collision between trains belonging to two different roads running over the same track, and not a crossing collision as stated. The brake in use was the automatic vacuum. There is no evidence of any failure in it. The rear train was running only at 20 miles per hour, while the line was straight for a quarter of a mile back and more, as the map shows. That the three rear cars should have been "smashed into kindling wood" by so small a speed as that, will strike an American as strange, especially if, as alleged, the vacuum brakes were at once applied. At Revere, in a very similar accident, the speed was 25 to 30 miles per hour, and there were no train brakes applied, or to apply, in season, while the cars in New England were then (1871) far inferior to the present American standard. Out of 65 or 70 in the rear car 29 were killed and 57 injured, but nearly all by steam and fire. The locomotive boiler was buried in the car, but the latter was not otherwise much wrecked. The English locomotive boiler does not appear to have been ruptured at all. The "temporary suspension" of the block system, at a time when it was most needed, combined with the rear engineman having to make an unusual stop which he had not in mind, to accommodate the ticket collectors of an excursion train, who have to stop a train to take up tickets under the absurd English systems, seem to be the cause of the accident. Its relation to previous British accidents we have discussed elsewhere.—ED. ENG. NEWS.]



Extract From English Ordnance Map, Showing Scene of Doncaster Collision.

A Fine Opening for Some Young Man.

MONTGOMERY, Ala., Sept. 27, 1887.

EDITOR ENGINEERING NEWS:

Inclosed please find an advertisement, which may be useful to engineers who have nothing to do, and are not likely to get employment. Comments might be of service to the profession. Yours truly,

W. G. WILLIAMSON.

[The following is given verbatim without correction.]

TO CIVIL ENGINEERS.

HAYNESVILLE, ALA., Sept. 22, 1887.

I am directed to ask for proposals up to Oct. 20, for the survey of the projected railway from Montgomery by way of Hayneville to Camden, all in this state, with estimates based thereon of cost of construction. The air line distance is sixty-four miles from terminal points named. About forty miles of extra survey will be required. The whole cost not to exceed $900. Proposals must state when survey shall begin, which shall be at once, and continuous. Report and estimates to be made to me. Recommendations or references are necessary.

By order of the Executive Committee.

W. BREWER, Chairman.

We give this advertisement, which is cut from a local paper, free insertion. In fact, we cannot well do anything else, since the Executive Committee, although they are evidently well posted as to the market value of engineering genius, are not well posted as to how best to strike its fountain head, and did not authorize us to insert it in any other way. We cannot see how comment could be of service to the profession, and therefore make none, but we should be interested in knowing to what point competition may force the final contract price; perhaps to $300 or $400. — ED. ENG. NEWS.

Citizen GEORGE FRANCIS TRAIN, the originator of street railways, is taking up the cause of the condemned anarchists. He will give lectures, the proceeds which are to go to the men or their families.

SOCIETY PROCEEDINGS.

American Society of Civil Engineers.—The Subscriptions to the Building Fund are to date as follows:

Subscriptions previously reported	$8,085
P. F. Brendlinger	25
Pedro J. Sosa	100
F. J. Cisneros	200
	$8,410

Engineers' Club of Philadelphia.—At the meeting June 18, President T. M. CLEEMANN in the chair; 11 Members present, 4 new Members and 2 Associate Members were elected.

The Secretary offered the following resolutions, which were unanimously adopted:—

Whereas, The Club has examined United States Coast and Geodetic Survey Chart, No. 369[a], of the Hudson and East Rivers in the vicinity of New York, scale 1/80,000, with a view of considering the value of a proposed similar chart of the Delaware and Schuylkill rivers, near Philadelphia.

Resolved, That the Club is highly pleased with this form, arrangement and scale, and have no amendments or changes to suggest, and believe that such a chart of the Philadelphia rivers would be of great value to the profession and the public.

Mr. JOHN L. GILLS, Jr., presented a description of a new system of Screw Threads which he had arranged, and asked that a committee be appointed to examine and report upon the same.

The Secretary presented, for Mr. E. L. CORTHELL, an illustrated account of "A Venetian Ship Railway," and for Mr. C. H. MIDDLETON, Jr., an interesting letter descriptive of "Camp Life on the Union Pacific Railway Surveys," and for Mr. R. M. BACHE, an illustrated description of a "Boat Telemeter." Mr. S. P. MITCHELL presented an illustrated description of the "Susquehanna River Bridge of the B. & O. R. R."

LATEST CHANGES OF ADDRESS, AMERICAN SOCIETY OF CIVIL ENGINEERS.

FRANK BRUEN, Box 253, New Haven, Conn.

L. E. CHAPINO, Rooms 47 and 48, Produce Exchange, Toledo, Ohio.

O. H. P. CORNELL, Room 25, 53 Broadway, New York City.

JOHN J. DONOVAN, Engr. in Charge, Helena & Northern R. R., Helena, Mon.

E. B. GOSLIN, Asst. Engr. Department of Docks, New York City.

O. E. MICHAELIS, Capt. Ordnance Corps U. S. A., Kennebec Arsenal, Augusta, Me.

C. D. PURDON, Texarkana, Texas.

J. W. SCHAUB, Windsor Hotel, Montreal, Canada.

PERSONAL.

Mr. O. H. P. CORNELL, M. Am. Soc. C. E., who is the Republican Candidate for State Engineer and Surveyor, was the candidate of that party in 1875, but was defeated by his Democratic opponent Mr. JOHN D. VAN BUREN, Jr., M. Am. Soc. C. E.

Mr. S. R. CALLAWAY, Vice President and General Manager of the Union Pacific R. R. Co., has been elected President of the Toledo, St. Louis & Kansas City R. R. Co. to succeed Mr. JAMES M. QUIGLEY, who has resig

Mr. C. F. RESSEGUIE, who has been for two years Superintendent of the Illinois lines of the Chicago, Burlington & Quincy R. R. Co., has resigned this position to accept an appointment as Superintendent of the Idaho Division of the Union Pacific R. R. He will have charge of 1,100 miles of road, and his headquarters will be at Pocatello, Idaho.

Mr. JOHN BOGART, Secretary of the American Society of Civil Engineers, was nominated by acclamation by the Democratic Convention at Saratoga this week for the office of State Engineer. Mr. BOGART, however, declined the nomination owing to more remunerative employment as an engineer.

In answer to several requests for the address of the English contractor who is to build several hundreds of miles of railway in the Argentine Republic we would say that a late English journal gives it as—Mr. JOHN JACKSON, Contractor, Eastbourne, England. The same journal says that Mr. JACKSON has just ordered "40,000 tons of steel rails" from Sheffield.

Mr. P. P. SHELBY, who recently resigned his position as Traffic Manager of the Union Pacific R. R. at Salt Lake City, has been appointed General Manager of the Montana Central R. R., with headquarters at Helena, Mont. This line is the extension of the St. Paul, Minneapolis & Manitoba R. R. west of the Missouri river. The road will soon be completed to Helena and to Butte, Mont., in the spring of 1888. There are various extensions contemplated to the mining districts in the vicinity, where business is expected to be very profitable. It is also part of the programme to extend the line west to the Pacific coast within two or three years, although the exact route has not yet been agreed upon.

Mr. EDWARD BURGESS, who has done so much for American yachting and whose only competitor is himself, is 37 years old, a native Bostonian, and was until lately a member of the shipping firm of BENJAMIN BURGESS & SONS. He is a graduate of Harvard in the class of 1871, and for a time performed the duties of Professor of Natural History at Harvard, having from an early period displayed a particular bias in this direction. He has not abandoned his natural history studies, even in the midst of his late yacht-building victories, and any strange specimen of the insect world will still claim his attention above all else. He is however, a yachtsman born and was at the same time Secretary of the Eastern Yacht Club and of the Boston Society of Natural History, thus uniting his two hobbies. A very few years ago he commenced to make yacht-designing a special business and his success has been phenomenal. The *Puritan*, *Mayflower*, and *Volunteer* are the boats upon which his just fame has been built. But besides these marvels he has designed sloop *Colina*, the cutter *Boudina*, the cat-boats, the *Sachem Wraith* and *Fisherman*. As the associated naturalists last November presented Mr. BURGESS with a costly testimonial of their esteem, it is high time that the American yachtsmen recognized in a fitting way the genius that has so ably maintained our reputation for building fleet-winged racers. And we have no doubt that this will be done in a magnificent shape.

Fruit of the Chatsworth Disaster.

The following circular of directions for special or excursion trains, carrying passengers for the Grand Army encampment, Sept. 26th and 27th, 1887, has been issued on the St. Louis & San Francisco Railway:

SPRINGFIELD, Mo., Sept. 15, 1887.

1. Not more than one train or engine will be allowed on the main track between any two telegraph stations at the same time.
2. One engine and twelve cars will constitute a train, and only one engine is to be used, and no more cars than the engine can easily and readily haul.
3. Freight trains will be reduced in number to the lowest practicable limit, and no freight trains will be permitted to occupy the main track within one hour of the time that any special passenger trains are due, or within thirty minutes of any regular passenger trains.
4. All switches must be locked or spiked while the excursion or heavily loaded passenger trains are passing.
5. Section men will walk the track, over their section in advance of each train, and give especial attention to such portions of the road where there are heavy grades or curvatures, or obstructions that may obscure the view so that engineers cannot see at least 1 mile ahead. All wooden bridges and openings of every kind will be closely watched and inspected.
6. Engineers failing to get clear signals while approaching stations or sharp curves, or heavy down grades, will slow down to a speed that will give them full control of their train.
7. All officers and employés will exercise the utmost vigilance and activity in leaving nothing undone that will secure the safe movement of the trains upon the entire road, which will include the closest inspection of roadbed, track, switches, machinery and equipment.

Iron Centering for Colliery Roads.

According to M. GERRARD unusual difficulties in maintaining the main roads have been met with at the Rochebelle Collieries on account of the numerous faults and shifting of the ground. After the failure of timbering of the stoutest dimensions, various forms of iron-arched frames with vertical sides resting on wooden sleepers, and of horse shoe and elliptical iron frames, were tried. All of these failed. The final arrangement consists of circular frames made in halves and united either by fish-plates or chairs keyed up with wooden wedges. These have proved completely successful. They are made of T or channel iron weighing 22 lbs. to the yard, or of old rails weighing 28 lbs. to 44 lbs. per yard. The diameter of the circle varies from 4 ft. to 6 ft. inside measurement.

The average cost for light frames is about $2.47 per frame; packing 100 ft. round poles, 36 cts.; fixing, 20 cts.; total, $3.03. As the frames are fixed about a yard apart this gives the cost per yard. Wooden frames in the same road cost, including repairs, $4.18 per yard, and 64 cts. per annum must be allowed for future repairs. The result is decidedly in favor of the iron frames.

An important advantage of this system is the small space occupied by the frames. Thus, on comparing three systems, the following results are obtained:—

Cross-section of Roadway.

With	Gross sq. ft.	Clear sq. ft.	Proportion Per cent.
Iron frames	33.8	27.4	81
Timbering	78.6	40.9	52
Brick arching	84.5	31.2	37

In other words, for every square foot of useful area of roadway the area excavated will be—for iron frames 1.23 sq. ft., for wood frames 1.92 sq. ft., and for brick arching 2.70 sq. ft. The cost of driving will consequently be greatly lessened if iron frames are used.

Iron has been adopted instead of wood for packing and sheeting. For this purpose iron laths, square rods and ¼ in. wire have been tried, and, if carefully applied, there seems no doubt of the ultimate success of this system.—*Journal of the Iron and Steel Institute.*

Cost of London Buildings per Cubic Foot.

In the course of the evidence given by experts regarding the disputed "cubing" of the proposed Admiralty and War Offices, in London, Mr. LEWIS H. ISAACS said that he was the builder of the Northumberland Avenue Hotel (now the Hotel Victoria and a very ornate and substantial stone structure) and the price per cu. ft. was 36 cts. The terminus of the London, Chatham & Dover Railway, including the Spiers & Pond Hotel on the Holborn Viaduct, cost 32 cts. per cu. ft. The Holborn Town Hall, a plainer building of red brick and stone dressing, cost 28 cts. per cu. ft. These buildings were all erected with a close eye to economy. The St. Thomas Hospital, a plain building of brick and stone dressings, cost only 18 cts. per cu. ft.; and the Railway Clearing House in Euston Square, built in 1881-2, cost 13 cts. per cu. ft., the contents being taken from the underside of the foundations, 5½ ft. below the level of the lowest floor, to halfway up the roof. This price included the total excavation and under-pinning of the walls of adjacent buildings. The new Post Office building, erected by the Office of Works, cost 17 cts. per cu. ft., and in this connection the statement was made that with internal arrangements much the same, the difference between a stone building and one of brick with stone trimmings, would be 2 cts. per cu. ft. in favor of the latter.

In the case of the Northumberland Avenue Hotel the foundations alone cost $100,000, as water and running sand had to be dealt with, and a solid mass of concrete 6 ft. thick underlies the whole area. The cost of the whole cube of this building was 36 cts. per cu. ft. as before stated. The Clearing House in Euston Square, which only cost 13 cts. per cu. ft., had a foundation of an excellent character. The St. Thomas Hospital price did not include the cost of removing a considerable depth of alluvial deposit overlying the London clay. Mr. ISAACS seemed to think that 20 cts. per cu. ft. was a fair average price and amply sufficient for the erection of buildings like the proposed Admiralty and War Offices, including interior and foundations.

Mr. JOHN LEMING was the next builder to give evidence. He estimated the cube cost at 24 cts. for the main building, and 36 cts. for the features above the roof, in the buildings under discussion. In giving detail he said the cubical contents of the original scheme were 13,632,740 cu. ft.; the basement was priced at 18 cts. and the superstructure at 24 cts. per cu. ft. Later investigation showed that the foundation was more difficult than originally supposed, and the whole contents were put down at 24 cts. per cu. ft. The items put at 36 cts. include the campanile and decorative work above the roof. Mr. LEMING did not think that Mr. ISAACS had taken into proper consideration the greater number of small rooms that would occur in a building like the Victoria Hotel. If the buildings for the Government were of brick he would put the price at 22 cts. per cu. ft.

It is interesting to compare these English prices with the figures given by Mr. TRAUTWINE in his Pocket Book for the approximate cost of American buildings. According to this authority a plain brick Philadelphia building would cost 12 to 15 cts. per cu. ft.; the better class, highly finished throughout, 15 to 18 cts.; first-class houses with cut stone fronts, 20 to 30 cts. Large plain buildings, such as brick churches, schools, theatres, court houses, etc., would cost from 12 to 16 cts.; while ornate church structures of large size with much cut-stone, will cost from 30 to 45 cts. per cu. ft. exclusive of spires. Large plain buildings of brick or rubble, such as railway shops, depots, station-houses etc., can be figured at from 9 to 12 cts.; or with ornamental finish and best materials, at 15 to 20 cts. First-class city stores, with marble fronts, high stories, of "fire-proof" construction and best materials and workmanship, cost from 18 to 25 cts. per cu. ft. As wil

be seen these figures are somewhat under the English figures given above, though we believe Mr. TRAUTWINE does not include in his data any extras for difficult or unusual foundations.

City Transit.

BY FRANCIS E. GALLOUPE, M. E.

The rapid growth of the passenger transportation business of leading cities, with the much discussion of the rapid transit problem during the last year or two, makes the facts as to what this traffic is, under the varying conditions as to situation and facilities in different places, of great interest at the present time. It is difficult to show the returns of street railway traffic even now, with completeness or with any great degree of accuracy, and it is much to be regretted that returns for former years have not been generally made up so that comparisons as to rates of growth compared with that of populations and other facts which might be deduced from them can become readily known. Each city has heretofore been supplied with this service, most essential to the city's growth and vitality, by competing lines in an almost crude and haphazard manner, compared with what it might be in economy and efficiency, the number of independent lines thus serving the public rising to a score or more in the larger cities, operated under separate corporate organizations. This adds to the difficulty of obtaining accurate totals. In only one city, Boston, has the process of consolidation yet begun, and there purely as a private enterprise for the benefit of private interests. If, as seems probable, important advantages in economy of management and to the public service will be the practical result of this movement, as in the case of steam railroads, which are everywhere combining into systems, consolidations of intra-mural lines will soon also take place, and the present existing comparatively short, detached lines become things of the past.

The following table shows the present number and extent of street railway lines in leading cities of the United States, with populations, by which the traffic of different cities can be compared:

No. Lines.		Population. Last census.	Present, (est).	Miles, Line.	As single track.	Cars	Horses.
24	New York,	1,243,600		134	268	2,205	16,327
22	Brooklyn,	806,663	2,250,000	136	280	2,250	8,596 *a*
1	Jersey City	120,722		—	28	80	625 *b*
					576	4,535	25,548
21	Phila..	847,170	1,000,000	419	486	1,894	10,348 *c*
12	Boston,	390 393	600,000	—	280	1,868	8,904
1	Provide'ce	118,070	125,000	—	53	280	1,294
7	Chicago,	503,185	600,000	—	318	2,258	8,262 *d*
18	San Fran..	233,959		—	125	622	1,735 *e*

a besides 27 steam motors of 1,080 horse-power.
b " 12 " " " "
c " 9 " " and cable engines of 1,800 horse power
d " 3 " " (20 h. p.) " " " 10.2 0 "
e " 17 " " " " " 1,690 "

Comparing the mileage, reckoned as single track, of these cities with the present population it is found that Chicago has 53 miles for each one hundred thousand of inhabitants; San Francisco, 50; Philadelphia, 48.6; Boston, 46.6; Providence, 42.4, and New York, taken collectively with Brooklyn and Jersey City, all being situated practically within a five mile radius about the City Hall, 25.6. In the latter case of course the elevated railway track mileages of 84 in New York and 13 in Brooklyn, or 97 total, should be added to the figures in the table, which, however, only brings it up to 30 miles per one hundred thousand. The totals of the grouping of the first three cities not only shows the pre-eminence of New York in extent of the appliances for passenger traffic over any other city in the country, but that it is the worst supplied of any in the list in proportion to the population. For Chicago has 76 per cent more mileage, San Francisco 66 per cent.; Boston, 55 per cent. more, in proportion to population, while Philadelphia comes between the last two cities.

In regard to motive power, it is seen that Chicago greatly leads in the extent of its adoption of other mechanical power than that of horses, by means of its cable lines. As compared with the number of horses, there is 1.23 times as much motive power in Chicago obtained from steam engines. Brooklyn derives 12.5 per cent. of the power for its cars from steam; Philadelphia 14.5, and San Francisco over 93 per cent.

Boston leads in the consolidation of its lines. Of the twelve lines existing in Boston and its suburbs, the management is now reduced to but two independent companies, the West End Street Railway and the Lynn and Boston companies, although actual consolidation has not yet in all cases been wholly carried into effect.

In another article these lines will be further studied in regard to their comparative capital, debt, cost and passenger traffic.

Errata in "Economic Theory of the Location of Railways."

The following is a list of the errata in the first revised edition of the ECONOMIC THEORY OF THE LOCATION OF RAILWAYS, *which have been corrected* in the second revised edition:

Page.
viii. line 5, (from bottom) *for* fast *read* task.
v. " 8, *for* If *read* of.
26. Table 7, middle, *for* 611.46 *read* 11.46.
31, line 19, *for* owners, *read* owner.
42. heading to note, *for* Table 5 *read* Table 6.
45, Table 10, heading, *read* Mileage, Cost, etc., of European Railways.
55, line 3, *for* short-hand *read* haul.
55, " 10, " proceeded " preceded.
66, " 3, *read* $200,000 × 6.19 = $38,000.
66, " 5, " total ($217 per day) $79,280.
77, " 6, (from bottom) *for* 14 *read* 14½.
96, (middle of page) *for* 29 to 80 *read* 29 to 78.
111. (per cent., column) *for* 93.4 *read* 92.4.
113, (near end par. 101) " assuerd *read* assured.
114, (note at bottom) *for* groups *read* group
119, par. 110, (5th line) " had lost " has lost.
124, par. 120, (1st line) *for* $150 *read* $120.
" " " (2nd " " $330 " 330, (no dollar sign).
" " " (5th " " $220 " 220. " " "
145, 2nd line last par. *read* "as 125 to 100, sometimes even 177 to 100."
154, 3rd col. of table, *for* 35.2 and 15.2 *read* 35.1, 15.4.
" 7th " " " 12.9 *read* 12.0.
155, next to last col. " 71.9 " 74.9.
" preceding col. " 11.7 " 1.7.
" 2nd col. of lower table *for* 27.4 and 72.5 *read* 7.4, 71.5.
179, YARDS AND STRUCTURES, *for* 8.5 p. c. *read* 8.0 p. c.
195. line 7, *for* that a *read* any.
200, 2nd line of note, *for* p. 441 *read* p. 810.
208, line 1, *for* 26 000 to 35,000 *read* 2 600 to 3,500.
" " 4, " 260 " 26.
" " 5, "388.89 to 247.62 " 38.89, to 24.76.
" Note added. *Passenger trainmen often make much more than this, often running 6,000 or more miles as a month's work.
211, line 4 *for* $42 87 *read* $4.29.
259, next to last col. near top, *for* 30.9 *read* 20.9.
" last col. 3d no. *for* 50 *read* 60.
269, line 15, *for* $\sqrt{\frac{60}{2}}$ *read* $\frac{60}{\sqrt{2}}$
281, last line, *for* shippage *read* slippage.
284, *read* For a 12-ft. wheel base 0.0127 foot, etc.
" last line *read* $d \times \frac{g}{r}$
286, line 16 *for* .0082 *d* D *read* 0.0 82 *d* D.
" formula, *read* $\sqrt{.00082^2 + .00087^2}\ d\ D$.
" table, 3d line, *read* .087, .435, 0.87, 1.74.
" " total, " .290, 1.450, 2.90, 5.80.
" " average, " .073, ..363. 0.73, 1.45, 0.13.
" " last col. *for* both .0089's *read* .0087.
298, " formula, *for* $C = 0.2335$ *read* $C = .02335$, etc.
" par. 323, 4th line *for* Its amount *read* The weight.
" " " 6th line " the weight " this force.
299, line 10, *for* least lightly *read* most lightly.
300, par. 326, line 9, *for* + *read* ×.
333, line 1, *for* 64.32 in this equation *read* 32.16 above noted.
" line 2, *for* 54.32 or 74.32 *read* 22.16 or 42.16.
337, line 12, for *guide* read *grade*.
" end of next to last line *read* 284 ft. (2.84—
338, last line of *Ex.*, *read* 12.60—0.50—0.8 = 11.30 + 0.90 = 12.56.
340, line 7, *for* $ab = ac$ *read* $bc = ac$.
" par. 382 line 4, *read* per cent × 20.
341, last line par. 385, *read* Table 120, 180, pp. 356, 579.
347, line 14 *for* (corresponding to a *read* (being nearly the.
" next line *for* of *read* for.
500, 4th. no. of last col. *for* 6.30 *read* 5.30.
628, tabular matter, top line, *for* 80° per mile *read* 50°.
" " " next to last line *for* 50° *read* 80°.
630, base line of cut, *for* 400 *read* 200.
747, line, *for* stillness *read* stiffness.
768, 5th line from bottom, *for* WOOD-BEDS *read* ROAD-BEDS
841, 3d line of 3d par. *for* above Fort Benton *read* below
864, end par. 1186, *read* par. 1242.
923, 2d. line, *read* par. 635.

The following are corrections received since the issuing of the second revised edition, and will not be made in the plates until the third edition appears:

PAGE.
38, table, 6th col. *for* 934 *read* 93.4.
234, line 15, *for* created *read* credited.
288, line 1 of par. 305, *for* follow *read* follow, and *for* shippage *read* slippage.
289, table, last line, *for* .72, 1.44 *read* .54, 1.08.
" 1st line below table, *for* Table 110 *read* 100.
320, line 14, *for* per degree of curve *read* per mile of curve.
326, 1st line of 6th par., the word builders misspelt.
379, line 13 from bottom *for* 123 *read* 124.
396, 1st line of table *for* $265.50, $26,550 *read* $2655.00, $266,500.
396, line of totals, *for* $15,536.50 $155,365.00 *read* $17,935.00 $179,350.00.
396, 3d line below table *for* $3,219,500 or $11.097 *read* $2,562,000 or $12,819.
714, last line of table, *for* 1,396. *read* 1,439,097.

" To population given for 1875 add following footnote: "The official revised State Census gives the city population for 1875 as 726,386. The writer believes these figures to be entirely untrustworthy, and therefore disregards them.
883, 5th line of par. 1131 *for* file *read* fill.

A correction suggested to Table 106, page 270, last line, of *A W* in place of ¼ *W* is not correct. The table is right as it stands.

The writer desires to acknowledge with thanks the courtesy of those who have sent in the preceding corrections (which he is thankful are no more), a large part of them having been sent in by two or three persons independently, and to request that others who may detect further errors will duly advise him of them

Battle Creek Station Specifications.

(*Continued from page 229.*)

Tiles.—The large fireplace will have a hearth of 6×6 in. red unglazed tiles ½-in. thick, carefully laid on the trimmer arch and the joints run with red cement grouting. These tiles will cover the floor of entire fireplace and alcove.

The two vestibules and square halls between vestibules will have floors covered with unglazed floor tiles, carefully and accurately set in cement, and joints filled with grouting. Tiles to be selected by architects, and to cost 70 cts. per sq. ft. laid.

Gratings.—Over each window in baggage room and in express room, put wrought-iron gratings, each to be made of three cross-bars ½×1¼ in., with ends let into wall and turned up, and round vertical rods ½-in. in diameter and spaced 2 ins. between centers. Furnish strong cast-iron grates, 14×20 ins. to go over openings left in platform to ventilate spaces under both buildings. These grates will be firmly screwed in place.

Anchors.—All the wall plates will be anchored to wall by anchors furnished by carpenter. The several tiers of joist in tower will also be anchored to wall, by anchors furnished by carpenter.

Beams.—To support the brick wall over fireplace alcove opening, use two 8 in. 65 lbs. per yd, rolled-iron beams, wall over these beams to be 12 ins. thick. There will be two similar beams to support wall over opening into ladies' retiring room.

To support the corbelled part of boiler flue, use three steel railroad rails, one 10 ft. long, one 8½ long, and one 7 ft. long. All these beams will have two coats of mineral paint before being used, and will rest at ends on cast-iron plates, 8 × 12 × 1 in., dipped in asphalt before being used.

CUT STONE.

The grade course entirely around both main building and baggage house, will be of Euclid bluestone, 8 ins. high and 6 ins. in the wall, and laid on its natural bed. The sills in arch of both vestibules, also all door sills coming in this course, will be of Medina stone. All this stone will have the faces six cut.

Caps.—The three piers built for the posts of shed connecting main building with baggage house, will all have Euclid blue caps 16 ins. square and 6 ins. thick.

Red Stone.—All the stone work colored brown on the plans, elevations and sections, will be No. 2 Portage entry red stone, free from all sand holes, stains, and other flaws of any nature, and laid on its natural bed. Care must be taken to use no stone which has been quarried in frosty weather, and hence liable to split. All sills, sill courses, transoms, lintels, mullions, voussoirs and quoins will be, unless otherwise specified, rock face, with washers, reveals and soffits tooled. All sills and transoms will have washes and lugs cut on them, and all window and door sills, similar stones will be set firm at ends, with no mortar under the middle.

The jambs and quoins of the windows of tower will be of different heights, and lengths as shown; but those of windows of telegraph office will be of such heights to fit the brick work.

Ashlar.—All ashlar work including chimneys above roofs will be random work, with horizontal beds and vertical joints. The joints of all red stone work to be 15-19 in. stones to average not less than 12x12 ins. and all stone work will go into wall not less than 6 ins. at any point, and at least one half of stones to go into wall 10 ins. All ashlar will be rock face and will *not* have draft lines cut on any corners.

The chimney caps will all be cut as shown, rock face in long pieces well clamped together with wrought-iron clamps dipped in hot asphalt before using.

Tower.—The top tower will be built as shown with sills, mullions, transoms, voussoirs, etc., entirely of red stone.

Carving.—The two bosses under label of entrance arch on railroad side of main building; also the sill course from each boss to inner edge of arch, including the reveal, also the two bosses under label of side arch of porte cochére will be carefully cut and carved from full size drawings to the satisfaction of the architects.

The coping of side wall of *porte cochére*, will be cut as shown, and to be made in not more than three pieces, and bedded in pure cement mortar. This coping will not be put on till near completion of building.

Corbels.—There will be built into walls where shown, red-stone corbels of size and cut as shown, under the brackets supporting overhanging roofs and under the beams spanning the entrances to the *porte cochère*.

Mortar.—All the mortar used in the construction of the buildings above the foundations will be composed of 1 part Buffalo cement, 1 part well burnt lime and 3 parts clean sharp sand. All to be well mixed and joints of brick work well filled with mortar.

Pointing and Staining.—All the facing of exterior walls of both main building and baggage house, including the side walls of two vestibules, and also all the face brick work of fire place, will have all joints carefully raked out at least ¼-in. deep and afterwards filled with red cement mortar, all as directed and to satisfaction of architects. The joints of stone work will be ⅛-in. All joints of both brick and stone work will be carefully struck with a steel jointer on a straight edge, and the brick walls will afterwards have two coats of Boydell Bros. best brick color—the first coat to have plenty of oil mixed with color and nothing else—the second coat to have a small quantity of oil—a large quantity of turpentine and a little wax applied to give an even and regular and dull finish. The stone work will be washed clean with water and a little acid if necessary. Before leaving point up under all sills similar stones.

Drains.—All drains will be laid where and of sizes shown with regular and even slopes, and with all necessary Y-branches, etc., (no T's). These drains to be of best salt glazed earthenware pipe with joints set in Portland cement and well brushed out, and all turns will be made with regular bends and curves.

There will be two lines of drains leading to river, one from ladies' end of main building and one from baggage house. This last will collect all water from gentlemens' end of main building as well as water from baggage house and shed connecting two buildings. Both lines will run out to a point 20 ft. from main front line of main building. This drain wherever coming inside the walls of building will be of iron and laid by plumber.

MISCELLANEOUS.

The contractor shall obtain all necessary surveys for setting out buildings, give all notices required by law, obtain necessary building permits, licenses, to provide all necessary fences, lights and other guards required by law during the progress of the work, and to make good all damages to neighboring property. He is not to disturb or injure the trees, or terraces now on this property. He is to do all necessary cutting for plumbing, heating and ventilating; point up around all window and door frames, and clear away all his rubbish when work is completed. All arches are to be built on centers, to be supplied and set by carpenter, and the mason is to assist the carpenter to level up the beams. All walls are to be covered up during the night and during rains, to protect them from injury when necessary.

(TO BE CONTINUED.)

STATISTICS OF NEW WATER-WORKS CONSTRUCTION.

(Specially Communicated.)

CONTINUED FROM PAGE 211.

Highlands, Col.—The works were commenced April 4, 1887, and were accepted by the company Aug. 1; they were designed by J. BRYAN, and A. L. HOLMES was the Constructing Engineer, and contractor for the whole works. The pumping machinery was furnished and the masonry and foundations and the receiving tank were built by Fairbanks, Morse & Co. Pipe, specials, valves and hydrants were supplied by the Michigan Pipe Co., Bay City, Mich. Water is taken from artesian wells and pumped to a tank elevated 400 ft. above the pump. There are 9½ miles of 2-in. to 6-in. pipe, and 51 double fire hydrants of Gaskill make. Valves were made by the Galvin Brass & Iron Works, Detroit, Mich. The franchise is for 20 years and is owned by the Beaver Brook Water Co. M. C. JACKSON is President, W. WHITTAKER is Secretary and JAS. BRYAN is Superintendent. The price paid is $40 per hydrant. The total cost of the works was $145,000. The city has a population of about 7,000.

Palmer Lake, Col.—The works were commenced June 12, 1887, and were accepted Aug. 23. They were designed by J. H. DRINKWATER and built by A. L. HOLMES, Grand Haven, Mich. Pipe, specials, valves and hydrants were furnished by the Michigan Pipe Co., Bay City, Mich. Valves from the Galvin Works, and hydrants of the Gaskill make. Water is taken from a reservoir on Monument creek and conveyed in pipe by gravity to the town. There are 1½ miles of 3 and 4-in. pipe and 4 hydrants. The franchise is for 20 years at $50 per hydrant. It is owned by the Palmer Lake Water Co. W. H. THOMPSON is President, J. H. DRINKWATER is Secretary, and W. HUGHES is Superintendent. The works cost $3,000. The population of Palmer Lake is about 1,000.

Glen Park, Col.—This town, lying near the preceding, is furnished with water by the same company, and the persons connected with the construction are the same as in the above. The supply is taken from the main of the Palmer Lake Company. There is about a mile of 2 to 4-in. pipe and 4 hydrants. The population is 600 and the whole cost of the works was $2,000.

Chillicothe, Mo.—Work was begun May 15, 1887, and the works were finished and tested Sept. 15. The plant consists of two compound duplex Worthington pumps of 1,000,000 galls. capacity each, and two tubular steel boilers of 80 H. P. each, furnished by the Pond Engineering Co. of St. Louis. There are two Hyatt filters, 6½ ft. diameter by 13 ft. high. All of the machinery is in a handsome brick pump house, which has also living rooms for engineer and fireman. Water is taken from Grand river, two miles from Chillicothe. The river being at times quite muddy, water is pumped through the filters into a clear water basin or reservoir of 125,000,000 galls. capacity; thence the water is taken by the pumps and sent to a steel stand-pipe 145 ft. high and 12½ ft. diameter, made by Shickle, Harrison & Howard, of St. Louis. The top of the stand-pipe is 225 ft. above the pumps. The average head on pipe system is about 200 ft. Pipe system consists of 13,000 ft. 12-in. pipe; 2,000 ft. 10-in. pipe; 4,360 ft. 8-in. pipe; 17,750 ft. 6-in. pipe; 5,900 ft. 4-in. pipe; all standard cast-iron pipe made by Shickle, Harrison & Howard, of St. Louis. There are 90 double-nozzle hydrants made by Ludlow Valve Co., also 30 Ludlow valves. Works were designed by Col. S. H. LOCKETT, Chief Engineer. J. M. WALKER was Resident Engineer; N. C. IRWIN, Business Manager. COMEGYS & LEWIS, of No. 15 Cortlandt street, N. Y., are owners of the franchise and contractors for construction of the works.

(TO BE CONTINUED.)

NOTE.—The above statistics of new construction are sent in response to special inquiries sent out by us to contractors, superintendents, engineers and others having to do with new works. We have a special blank for this service, and will be pleased to forward one or more on application. We invite co-operation in this special subject.

CONSTRUCTION NEWS.

Water.

Drainage and Irrigation.—*California.*—The Board of Directors of the Turlock Irrigation District at Modesto, Cal., have ratified the Engineer's plans for the proposed work, which is to cost about $600,000. An election takes place Oct. 8 to vote a tax.

Illinois.—Dredging for the drainage canals in Champaign county is at a standstill owing to the litigation between different drainage districts.

Minnesota.—Organizations under the new State drainage law have been perfected in Marshall, Polk, Norman, Clay and Wilkin counties in the Red River valley, and meetings are to be called to interest the people in the proposed work. National and State aid will probably be given.

New Works and Extensions.—*New England.*—At West Randolph, Vt., a gravity system has just been put in operation.——At Woodstock, Vt., the dam and reservoir are completed and the pipe laying is being rushed. T. William Harris & Co., of New York City, are the contractors.——Work on the laying of mains is in progress at Westerly and at Barrington, R. I.——The constitutionality of the bill allowing the city of Fall River, Mass., to obtain a supply from the lakes east of the city, is to be decided by the Massachusetts Supreme Court at an early date.

Middle States.—The works at Springville, N. Y., will be completed before cold weather.——At Worcester, N. Y., the contract for works has been let.——The new system at Montclair, N. J., is expected to be in operation by Oct. 15. There are 215 hydrants and 23 miles of mains, which are now nearly all laid. Head is afforded by an iron tank 40 ft. diameter and 30 ft. deep, located on an elevation. Duplicate pumps are used of the Worthington make, each of 1,000,000 gallons capacity. Water is taken from a well about 100 ft. in depth. Analyses of the water show it to be of excellent quality. ——A water company has been organized at Tarentum, Pa.——The Hyatt Pure Water Co. will begin work at once on a trial, filtering plant of 250,000 gallons capacity for the city of Allegheny, Pa.

Southern States.—Clarksburg, W. Va., has voted to issue $50,000 bonds for water works.——Jeter & Boardman, of Brunswick, have the contract for works at Albany, Ga., and Tampa, Fla.——At Sheffield, Ala., the East Sheffield Land Company proposes to erect water-works on its property.——At Decatur, Ala., the city has contracted with A. H. Howland and Geo. A. Ellis for a complete system, including pumping plant, stand-pipe and 20 miles of mains. This is in place of the contract made last spring with Inman Brothers, which became void by the contractors failing to begin work within the specified time.——Covington, Ky., is to ask legislative permission or the issuance of $400,000 of water-works bonds.

Ohio.—Ferris & Halliday, of Jersey City, are to build works at Fostoria. The direct pressure system will be used, and there will be 100 hydrants.——Samuel R. Bullock & Co., have been awarded the franchise for the works at Defiance.

Michigan.—Works are projected at Fentonville, Gaylord and Bellevue.

Illinois.—The Linsdale Water Supply Company has been incorporated, with capital stock of $50,000. E. W. Perry is interested.——At Paxton the contract has been let for works to cost $8,000.——Works are contemplated at Lyons.

Nebraska.—Bids close October 4 for the works at Pawnee City. The plant will include pumps of 1,000,000 galls. capacity, 100 ft. stand-pipe, masonry reservoir, and about 18,000 ft. of mains. A. A. RICHARDSON, Lincoln, prepared the plans and specifications.——At Long Pine bids will be opened October 8. The plans were prepared by A. A. RICHARDSON, of Lincoln.——Works are proposed at Rushville and Norfolk.

Kansas.—A water company has been organized at Richfield, Morton county. F. F. Stevens is interested. ——The works at Fredonia are completed and in operation.——At Valley Falls, bids for a complete system have been called for.——Works are proposed at Hayward and Glen Elder.

Missouri.—Plans are under way in the office of the St. Louis Water Commissioners for the underground conduit which is to extend from Chain of Rocks to Bissell's Point. Surveys begin at once at the site of the new pumping plant and the inlet tower.——Bids have been asked for a system of water-works in Columbia, Mo. JAS. C. ORR is City Engineer.

Texas.—Water-works are being discussed at Marshall, and are under construction at Taylor.

Sewerage. *Stockton, Cal.*—Work was begun on the plans and surveys for a system of sewerage two years ago under City Engineer E. E. TUCKER, and the designs have been approved by Colonel WARING, the consulting engineer. A recent message of the Mayor advises the City Council to at once pass an ordinance for a special election to vote the necessary bonds. Should that result favorably, as is probable, the contract for the work will probably be let at once.

Oakland, Cal.—The Board of Health have recommended the City Council to substitute iron manhole covers perforated for ventilation, for the tight wooden ones now in use. A thorough overhauling of the present sewerage system and its considerable extension is also proposed.

Cleveland, O.—The commission organized to find the best method for purifying the Cuyahoga river and the valley of Walworth run has been organized. Two plans have been proposed. One is to place two intercepting sewers on each side of the river, all sewers and runs to discharge their contents into these two large sewers, which will empty into the lake. This would be very expensive, but is believed by many to be the only way of solving the problem. Another way, suggested by ex-City Civil Engineer FORCE, would be to flush the river, thus creating a current which would carry off all offensive matter that might be in the river. It is said against this scheme that a current such as would be created would only remove the top, which is not very offensive, being mostly oil, and that the solid sewage, which is the cause of all the evil, sinks to the bottom where it would remain, as it does now. The commission will bend its energies to remove the cause. Any persons having suggestions to make relative to the purification of the Cuyahoga river or a proper sewerage or drainage of Walworth run or other tributaries to the Cuyahoga river are respectfully requested to present their suggestions in writing to the committee through City Solicitor A. T. BRINSMADE, Room 3, City Hall.

Jacksonville, Fla.—The city has outgrown the present sewerage system and in times of heavy rain the sewers are unable to take care of the surface water. The papers are calling for action by the City Council in reference to the matter.

Los Angeles, Cal.—The mayor has recommended a special election to vote $750,000 for a sewerage system.

New Rochelle, N. Y.—The village trustees have appropriated $3,000 for the plans and specifications for the proposed sewerage system, the estimated cost of which is about $100,000.

Fort Collins, Col.—The sewerage agitation has taken definite form.

Norfolk, Va.—(A CORRECTION).—Mr. H. L. SMITH, Superintendent of the Norfolk City Water-Works, writes us as follows:—"In your issue of Sept. 24, you state that the city council has let the contract to the Suffolk & Portsmouth Water Co. Such statement is an error and can be corrected by putting Portsmouth in place of Norfolk. At present Norfolk is supplied with water, and when an additional supply is needed will not obtain it through any contract with the Suffolk & Portsmouth Water Co., but will take water from the largest, nearest and most healthy supply in Virginia, namely, Lake Drummond."

Green River, Wyo.—The Strang Co., of Omaha, Neb., is building a water pipe, 16 miles long, for the Union Pacific, reaching from Green River to Rock Springs, where 5 of the coal mines of the company are located. Through this pipe, water will be forced from the former to the latter place for the use of the mines and the citizens of the place. There are about 1,000 miners engaged and the town comprises about 1,500 inhabitants. The consumption of water daily is about 150,000 galls. The supply for the last 18 years, with exception of that of a spring at the place which supplies about 80,000 galls. daily, has been by means of water trains, which run almost daily between the two places. These generally consist of 12 cars, each car containing about 3,500 galls. The cost of the pipe line will be about $150,000. It is laid 5½ ft. in the ground and about 150 men are engaged in the work. The pipe is 8 ins. in diameter and ascends a grade of 340 ft. The engines to force the water up this incline are located at Green River. At Rock Springs a reservoir is now being built which will contain 3,000,000 galls., 140,000 of which may be forced through the pipe daily.

Manchester, England.—The cost of the water works at Longdendale was $13,004,315, and that of the old company's works was $2,667,805, making a total $15,672,120. The total annual revenue is $1,065,000. Supply of water in 1886, 19,464,597 galls. per day. Area of drainage ground, about 19,300 statute acres, or 30 square miles. Distance of Manchester from Woodhead reservoir, 18 miles. Population supplied, about 1,000,000. Consumption equal to 20 galls. per head per day for all purposes. Area of district supplied, 84 square miles, comprising 34 townships. Compensation water, a quantity equal to 59 cu. ft. per second for 12 hours of every working day, divided by arrangement with the mill owners into about 16,800,000 galls. for the first five working days of the week and 11,000,000 on a Saturday. New works in course of construction at Lake Thirlemere, Cumberland: Elevation, 533 ft. above ordnance datum; area of drainage ground, 11,000 statute acres; present area of lake, 328¼ acres; area when raised, 735 acres; contents when raised, 1,300,000,000 cu. ft., estimated to supply 50,000,000 galls. per day; tunnels and aqueduct for conveying water to Manchester, 7 ft. diameter; grade 20 ins. per mile; total length, 95 miles; estimated cost of works, $17,123,650. The powers to construct these works were obtained in 1879 after two severe Parliamentary struggles. The total area of the reservoirs amounts to 854½ acres, and the total storage capacity 5,985,000,000 galls.

Chicago, Ill.—A syndicate composed of B. F. JONES, of Jones & Laughlin, Congressman JOHN DALZELL, THOMAS and JAMES ATTERBURY and MARK W. WATSON, of Pittsburg, Pa., propose to make an offer to supply the city of Chicago with water by the Atterbury system. This system consists in locating a plant in the gravel beds some 40 ft. below the surface and using the water thus secured. They have had men at work in the outskirts of Chicago and on the strength of their investigations say that they can secure sufficient water at a depth of 60 ft. to enable them to supply the city of Chicago without the aid of the present crib system. The samples of water obtained there were of the purest, and Mr. ATTERBURY, who is the inventor of the new system, says that they will be enabled to offer the municipality an abundant supply and put up the necessary plant for $500,000, and the system will bring about a reduction of at least 25 per cent. in the cost of maintenance of plant as compared with present methods. The syndicate has for some time had an experimental plant in operation at the Monongahela works at Pittsburg, which has worked very successfully.

While the names of the men at the head of the above syndicate preclude the idea that the scheme is of the wild-cat order, the Chicago authorities are not likely to look with favor on it now that the plans for the extension of the present system are so far advanced. In reference to this scheme City Engineer ARTINGSTALL is reported to have said, "We have gone to a depth of over 80 ft. at a great many places in the city, but found no supply of water which could not be pumped out by an ordinary jig-pump. You might find enough to run an elevator in a building or perhaps enough to supply a family, but the idea of getting enough to supply the wants of a city like this is simply absurd. Water can always be found at certain distances below the surface, but the large number of artesian wells throughout the city shows that it cannot be had in any quantity."

A site has been secured for the new pumping works on the south side and it is intended to let contracts very soon for constructing the new tunnel and extending the old one. The work will require nearly a year and a half for its completion.

Proposals Open.

Water Works.—Supply of artesian water and complete system of water-works. THE MAYOR, Bonham, Tex.

Sewer Work.—Vitrified pipe sewer, branches, manholes, etc. THOS. J. LANAHAN, Clerk, Board of Contract & Apportionment, Albany, N. Y. October 3.

Railroad.—Grading a single track road-bed from New Castle, Del., to the Shelpot branch at Christiana creek. Prices per cu. yd. for excavation, without classification, including hauling and depositing. Plans and specifications at the office of the Assistant Engineer, H. W. WEBBER, Wilmington, Del. WM. H. BROWN, Chief Engineer, Philadelphia, Wilmington & Baltimore R. R., 233 South Fourth street, Philadelphia, Pa. October 3.

Artesian Well.—Specifications on file. F. W. FRANCIS, Village Clerk, Coal City, Ill. October 4.

Street Work.—Grading, curbing and paving; lateral sewers. JAMES BROWN, Comptroller, Allegheny, Pa. October 6.

Water Pipe, Pumping Engine, Etc.—Cast-iron pipe 12,000 ft. of 36-in.; two horizontal, compound, condensing engines of 15,000,000 galls. daily capacity each, with boilers, etc. Plans and specifications at the office of City Engineer, and at the office of JOHN A. COLE, Consulting Engineer, 69 Ashland block, Chicago. ANDREW RINKER, City Engineer, Minneapolis Minn. October 6.

Cast-Iron Cylinders.—For the shafts of the new tunnel for the water-works. Plans and specifications on file JOHN WHITELAW, Superintendent and Engineer of Water-Works, Cleveland, O. October 6.

Flexible-Joint Water Pipe.—From Brooklyn, N. Y., to Governor's Island, with meter and connections complete. Capt. J. H. LORD, Asst. Q. M., U. S. A., Governor's Island, N. Y. October 7.

Swing Bridge.—Iron swing bridge and turn-table across the Illinois & Michigan canal at La Salle street, Ottawa, Ill. Lattice bridge, 120 ft. long, 20 ft. wide, trusses 18 ft. high, capacity 1,500 pounds per lin. ft. of moving load. GEO. F. BROWN, Secretary, Board of Canal Commissioners, Lockport, Ill. October 7.

Trenching and Pipe Laying.—THOMAS J. NEVILLE, Clerk, Executive Board, Rochester, N. Y. October 7.

Jails.—At Winchester, Conn., and New Milford, Conn. Architect, R. W. HILL, Waterbury. LITCHFIELD COUNTY COMMISSIONERS, Waterbury, Conn. October 10.

Dredging.—About 800 ft. of mud at Coaster's Harbor Island, R. I. For information apply to the Commandant of the U. S. T. S. "New Hampshire," Newport, R. I. JAMES FULTON, Paymaster General, U. S. N., Navy Department, Washington, D. C. October 12.

Sewers.—W. ELLWOOD WYNNE, Corporation Clerk, Avondale, O. October 13.

Wooden Platform.—North of storehouse pier at Blackwell's island, and removing part of pier. The DOCKS COMMISSIONERS, Pier A, North River, New York City. October 13.

Bridges.—Iron superstructures over Paddy run and Mill creek. Plans and specifications on file. FRED RAINE, County Auditor, Cincinnati, O. October 15.

Bridges.—Three county bridges, across Natches and Yakima rivers. Plans and specifications to be submitted, profiles to be obtained of the county auditor. WILLIAM F. PROSSER, County Auditor, North Yakima, Wash. T. October 15.

Street Railway.—Horse, electric or cable traction. The privilege of the streets will be granted to the party or company making the most advantageous bid. W. H. WEBSTER, City Clerk, Crawfordsville, Ind. Oct. 17.

Bridge.—Wrought-iron, double-intersection, high-truss bridge across San Antonio river, near the city of Goliad, length of span, 140 ft. 18 ft., roadway, 40 ft. above low water, upon cylinder piers of ⅜ in. iron, 4 ft. diameter, filled with concrete, resting upon stone or pile foundations. Approaches—One side 136 ft. and the other 55 ft., of best cypress or cedar piles, driven 7 ft.; benches of 3 piles each, capped with 10x10-in. heart pine, sway braces 2x10-in. heart pine, 16 ft. apart; 4x10 heart pine joists, supporting floors of 3½-in. heart pine plank; carrying capacity, 100,000 lbs. Bids for bridge complete, or for bridge and approaches separately. JAS. A. BURKE, County Clerk, Goliad, Tex. October 20.

Brick Buildings.—Lieut. EDWARD CHINOWETH, Fort D. A. Russell, Wyo. October 20.

Plumbing, Steam Heating, Etc.—Gas fitting, plumbing, steam heating, ventilating, cisterns, etc., for new court-house and jail. A. F. RANDOLPH, County Auditor, New Lexington, O. October 24.

Water-Works.—Construction and maintenance. Bids should state annual rental for about 125 hydrants, annual rental for additional hydrants and rates to water consumers. System is to be combined stand-pipe and direct pressure. No others need apply. Plans and specifications will be sent if desired. Pipes about 12.3 miles, from 16-in. to 6-in., none smaller. Population of city, 7,000; area, 2 sq. miles; assessed valuation, $1,800,000; taxes, 2% per. cent.

Torpedo Boat.—Hon. WM. C. WHITNEY, Secretary of the Navy, Navy Department, Washington, D. C. Nov. 1.

Jail.—Addition to county jail, 44x58 ft., with 42 cells. Separate bids for iron work. Plans and specifications at the office of R. N. ELLIS, County Engineer, Jacksonville. Capt. T. E. BUCKMAN, County Clerk, Jacksonville, Fla. December 5.

Contracting.

Street Work.—At Hartford, Conn., the Council has passed a resolution to appropriate $20,000 for the use of the Board of Street Commissioners for expenses of the street department during the current year, in addition to the sum heretofore provided.

Laying Water Pipe.—At Ottawa, Canada, the following proposals have been received by the Water-Works Committee for laying the pipes connecting the experimental farm with the city water-works: Jas. Delaney, $7,233; Tobin & O'Keefe, $7,280; Patrick Burns, $7,971. The contract was awarded to Jas. Delaney.

The Improved Sewerage and Sewage Utilization Co., of New York, acting under the patents of W. S. WEST, and organized in 1883, is said to have been placed in the hands of a receiver, on the application of Mr. A. J. ROBINSON who has obtained a judgment for $82,921 for work done and material furnished.

Road Work.—County Surveyor J. H. LASLEY, of Kansas City, reports that there are 47 miles of road to be completed by contract before the end of the year. Work is being pushed as rapidly as possible and about 1,000 men are employed. The principal force will be required for the five following roads: The Quindaro, the Shawnee, the Missouri river bottom, the parallel road and the Leavenworth road. Mr. LASLEY finds steady employment for 19 experienced engineers.

Levees.—The following were the proposals received by the Commissioners of the Fifth District Louisiana Levee Board for the Diamond Island levee: Peter J. Trezevant, 35 cts. per cu. yd., payable in bonds of the board at 10% discount from face value; Geo. Arnold & Co., same terms, 35¾ cts. per cu. yd.; John McGinty, same terms, 36 cts. per cu. yd.——The contracts for the Elbright and Alton levees, on which George Arnold & Co. and E. C. Manning tied as lowest bidders, at 20 cts. per cu. yd., were awarded to Geo. Arnold & Co.

Public Buildings.—The contract for the court-house at Winona, Minn., has been awarded by the County Commissioners to Munck & Lohse, of that city, for $103,000. It will be completed by September, 1889.——, The contract for the court-house at Evansville, Ind., has been awarded to Charles Pearce & Co., of Indianapolis, at $379,450. The architect is H. WALTERS, of Louisville, Ky.——It has been found that the court-house at Marshall, Ill., is not strong enough to support the proposed additions and a new structure will be erected at a cost of about $35,000.——The City Council of San Antonio, Tex., and the Court of County Commissioners will jointly build a court-house at a cost of $200,000.—— The contract for all the work not yet contracted for on the new city-hall at San Jose, Cal., has been awarded to P. B. Wells, for $117,000. The building will cost altogether about $136,400.

Railroad Contracts.—*Kansas City & Southern R. R.*—The contract for the timber to be used on the line between Kansas City and Lynn, 45 miles, has been awarded to F. P. Laws, of Beebe, Ark.

Port Arthur, Duluth & Western R. R.—The contract for the first 40 miles of this road, to the mines, has been awarded to Messrs. Grant & Ross. The work is to be completed by next August, and will open up a rich mineral field. The chief promotors of the enterprise are Sir ALEXANDER GALT, THOMAS MARKS, of Port Arthur, and ALEX. MCEWEN, of London, England.

Guelph Junction R. R.—The contract for the construction of the road from Guelph to Campbellville, on the Canadian Pacific, has been awarded to Ryan, Cosgrove & Booth. About 20 proposals had been received.

Dredging.—The following proposals for dredging the outlet of Chautauqua lake, have been received by JAMES SHANAHAN, Superintendent of Public Works, Albany, N. Y.: Willard Johnson, Fulton, N. Y., 21⅛ cts. per cu. yd.; E. A. Burroughs, Johnstown, N. Y., 24 cts.; Ross & Sanford, New York, 27 cts.; Hingston & Woods, Buffalo, N. Y., 28 cts.; Grace & Stratton, Pittsburg, $1. The contract was awarded to Willard Johnson.

Major O. H. ERNST, U. S. Engineer Office, Galveston, Tex., has reported to the Chief of Engineers that the contract which he had made with Wm. Fagan, of New Orleans, to do excavation work in the ship channel of Galveston bay, has been withdrawn, owing to Fagan's failure to enter the contract in the time agreed on. He reported further that the contract would be relet.

Telephone Company.—A telephone company, with a capital stock of $10,000,000 is reported incorporated at Indianapolis, Ind., to manufacture the telephone patented by HUMBERT L. TODD, of Washington. The office will be at Indianapolis. The directors are HUMBERT L. TODD of Washington, Ind.; ASHTON TODD, of Newburg; FRANK M. TRISSEL, of Noblesville; THOMAS B. WARD, of Lafayette; CHARLES W. ADAMS, of Chicago, and E. J. ELLIS, of Washington.

Paint and Oil.—At New Haven, Conn., the following proposals have been received by the Bridge Committee of the Board of Public Works, for furnishing the paint and oil required for painting the four iron bridges belonging to the city:

Glenney & Son—Princess metallic paint, 1¼ cts. per pound; Masury railroad colors, 6¼ cts. per pound; raw oil, 44 cts. per gall.; boiled oil, 47 cts. per gall.

Booth & Law—Princess metallic paint, 1¼ cts. per pound; Masury paint, 6¼ cts. per pound; boiled oil, 46 cts. per gall.; raw oil, 43 cts. per gall.

R. B. Bradley—Raw oil, 44 cts. per gall.; boiled oil, 47 cts. per gall.; Princess metallic paint, $1.90 per hundred weight; Masury railroad color, 6¼ cts. per pound

Spencer & Matthews.—Raw linseed oil, 45 cts. per gall.; boiled oil, 48 cts. per gall.

T. G. W. Jefferson.—Masury railroad colors, 6¼ cts. per pound; Princess metallic paint, 2 cts. per pound; raw oil, 46 cts. per gall.

Thompson & Belden.—Masury railroad colors, 6¼ cts. per pound; Princess metallic, paint, 1¼ cts. per pound; raw oil, 42 cts. per gall.; boiled oil, 45cts. per gall.

Commissioner Reilly withdrew R. W. Bradley's bid for furnishing Masury's paint, and the contract for furnishing all the material needed was awarded to Thompson & Belden.

The work of painting the bridges was let by contract at an aggregate cost of $430, and a member of the committee who had obtained estimates from several painters, in reference to the probable cost of painting the four bridges by day's work, thinks that at least $80 has been saved by having the work done by contracts.

Sale of a Steam Roller.—On Monday, Oct. 3, at 11 A.M., a steam roller owned by the Department of Public Works, New York City, will be sold at the corporation yard, 119th street and St. Nicholas avenue. The terms of the sale are cash payments in bankable funds at the time and place of sale and the removal of the roller within 5 days.

Sewer.—The following proposals have been received for the construction of a sewer at Albany, N. Y.:

WORK.	Amount.	BIDDERS. Patrick Murray.	John Mc-Incree.	A. N. Brady.
9½ ft. sewer per ft.	1,400 ft.	$13.50	$17.00	$8.00
9 ft. " " "	50 "	12.00	16.00	8.00
8½ ft. " " "	658 "	14.50	17.70	8.00
8 ft. " " "	887 "	12.00	16.30	8.00
Excavation, mixed rock and earth.	Cu. Yds. 1,863	3.50	0.75	0.52
Rock excavation	2,851	4.40	4.35	4.00
Brick masonry	2,367	7.30	4.75	6.00
Brick masonry	3,897	11.10	9.10	9.25
Rubble masonry	263	6.00	6.00	7.00
Rubble masonry, from old rubble.	417	5.30	6.98	7.00
Filling	312	0.30	0.50	0.78
Limestone masonry	207	0.60	0.50	44.60
Granite	7½	20.00	15.00	45.00
Granite block invert, per sq. yd.	5,347 sq. yds.	30.00	35.00	22.50
Receiving basins, each	12	4.20	3.75	175.0
Lumber, per M	78,000 ft. B. M.	150.00	120.00	13.01¼
Iron manhole covers, per lb.	4,560 lbs.	20.00	20.00	13.01¼
Vitrified pipe, per cent. of list prices.		98 %	75 %	20, 50, 70 and 80 %
Spruce piles, each	400	4.00	0.50	4.00
Total of proposals		157,559.75	144,759.45	125,736.02

The contract was awarded to A. N. Brady.

Steel Gun Forgings.—Proposals were opened Sept. 27, at the Navy Department, Washington, D. C., for furnishing 22 sets of steel forgings for 6-in. breech-loading rifle guns, oil treated and annealed, aggregating about 136 tons, and of domestic manufacture. The Midvale Steel Company of Philadelphia was the only bidder. Their proposal was for supplying the forgings, rough bored and turned, oil treated and annealed, $129,284; with tubes, jackets and trunnions to be rough bored and turned by the Navy Department and the other work by the contractor, $108,799. No award has yet been made.

A Big Blast.—It is reported that at the Hopewell ballast quarries, near Princeton, N. J., a charge of 1,150 lbs. of dynamite was recently exploded, dislodging 8,000 cu. yds. of rock.

Flexible Water Pipe.—At Guayaquil, Ecuador, Mr. John F. Ward has the contract to sink a 12-in. flexible water pipe under the Guáyas river, 1,400 metres long, for $32,000, with $24.60 per metre for additional length over that specified.

Sewer Work.—*Youngstown, O.*—The following bids were opened Sept. 22 for the construction of a brick sewer in Wick street, 30 ins. diameter and about 1,925 ft. long, with 6 catch basins and 5 manholes:

King & McClun, 1,925 ft. at $2.25, $4,331.25; 6 catch basins, $180; 5 manholes, $130; total, $4,641.25.

John Megown, 1,925 ft. at $2.30, $4,427.50; 6 catch basins, $105; 5 manholes, $170; total, $4,702.50.

Con. O'Donnell, 1,925 ft. at $2.33, $4,485.25; 6 catch basins, $270; 5 manholes, $120; total, $4,875.25.

Davis & Caldwell, $1,925 ft. at $2.95, $5,678.75; 6 catch basins, $150; 5 manholes, $300; total, $6,028.75.

The engineer's estimate was $5,000. J. M. RENO is City Civil Engineer.

Montreal, P. Q.—Contracts have been awarded for building a sewer in Berri street, St. James ward, to R. Chartrand at $5.49 per yd. for the sewer and $4.00 per cu. yd. for rock. The portion in St. Jean Baptiste ward was given to T. Heffernan at $6.47 per yd.

Albany, N. Y.—The following bids have been received for laying a 12-in. vitrified pipe drain in Yates street from Lexington avenue to Robin street:

	Vit. pipe per ft.	Y branches.	Receiving basins.	Manholes.
Jacob Holler	$0.73	$2.55	$62.00	$75.00
John Doyle	.90	3.00	61.00	60.00

The contract was awarded to Jacob Holler. (*Also see table.*)

Steel Guns.—The Navy Department received the following bids for steel cast guns, in response to the advertisement calling for proposals "for the purchase and completion of three steel cast rough bored and turned six-inch high power rifle cannon of domestic manufacture, one of which shall be of Bessemer steel, one of open hearth steel, and one of crucible steel." The Pittsburg Steel Casting Company bid for the Bessemer gun, rough bored and turned, $3,300. The Standard Steel Casting Company, Thurlow, Penn., bid for the open hearth gun, rough bored and turned, $5,300. These were all the bids received. A condition of the contract is that no casting shall be paid for until the gun shall have been completed and successfully stood the statutory test.

Electric Lighting.—The prevailing price for furnishing electric street lamps in the city of New York, has been about 70 cts. per night per lamp of not less than 1 000-candle power. At a meeting of the Gas Commission, last March, Mayor HEWITT denounced this as exorbitant, and since that time there has been some sharp rivalry between the various companies, with a result exhibited in the following schedule, showing the contracts awarded to the various companies at a recent meeting of the Gas Commission:

The United States Illuminating Company,
15 lamps at 24 cts. each per night.
38 " " 40 " " "

The Brush Electric Illuminating Company,
105 lamps at 25 cts. per night.
17 " " 40 " "

The East River Electric Light Company.
271 lamps at 19½ cts. per night.
191 " " 39 " "

The Mount Morris Electric Light Company,
15 lamps at 40 cts. per night.

The Harlem Lighting Company,
116 lamps at 24 cts. each per night.
12 " " 50 " "
7 " " 60 " "

The American Electric Manufacturing Company,
93 lamps at 32 cts. each per night.

The North New York Lighting Company,
26 lamps at 40 cts. per night.

In considering the arguments of the various companies the Gas Commission called to their aid Lieut. John Mellis, an electrical expert; and the following interesting data were given in his report:

There is an apparent discrepancy between the theoretic power of the electric light, and the results of practical experience regarding the number of gas lamps which can be replaced by one electric lamp in street lighting.

By measurement the electric-lamp as used in the streets of this city has from twenty-five to thirty times the power of a gas-lamp, or since the distances at which the luminous effects are equal are proportioned to the square roots of the intensities, the electric-lamp should be as effective at 250 ft. as the gas-lamp at 50, and if it were a question of illuminating an open area, one electric-lamp would be equivalent to 25 or 30 gas-lamps. But in street lighting, the fact that the streets are narrow compared to the full range of a powerful electric light, and the existence of numerous obstructions, such as telegraph poles, trees, awnings, elevated railroad structures, etc., render it impossible to realize the full theoretic value of the arc light, and it becomes necessary, in order to provide sufficient light in all places where required, and prevent the deep shadows cast by obstructions, to provide a great excess of illumination over what theory would indicate as necessary.

From the last annual report of the Superintendent of Lamps and Gas it appears that the average number of gas-lamps replaced by each electric light now in use is 4.516, the number varying from 2.7 on Chambers street, between Broadway and North river, to 8.74 on Park avenue, between Thirty-fourth and Forty-second streets. This variation shows the effect of local conditions since the gas and electric lamps are about the same in all parts of the city, and in any case, it is evident that the establishing of so large a proportion of electric lights to replace the gas-lamps, which is rendered necessary by the numerous obstacles to the free radiation of the light and by the fact that there must be at least one lamp at each street intersection, whatever the length of the blocks, results in a greatly increased amount of illumination, and this should be considered when making comparisons of cost.

With regard to the claim of the Harlem Electric Light Company, that each of their lamps would displace eight gas-lamps, it appears that this was not based upon any pretended superiority in the lamp itself over others in use for street lighting, but was made with the assumption that the lamps could be hung in the most efficient manner over the centers of the streets, and reference was had only to certain streets where the conditions were favorable. The electrical measurements indicated that the lamps were of the usual power of so-called "2,000 candle" lamp.

In reference to this claim for the superior manner of supporting the lamps the following conclusions were reached:

That the manner in which the experimental lamps are suspended in One Hundred and Twenty-fifth street, from an iron arm projecting out over the street, illuminates the street more efficiently than when the lamp is supported on a pole at the curb.

That the suspension of the lamp over the center of the street intersection, as was done at One Hundred and Twenty-third street and First avenue, is the most effective method for street lighting.

Bridges, Canals, & Etc.

Proposed Levee.—Dr. E. FOSTER, President of the Board of Health of Augusta, Ga., has suggested a plan for the protection of that city from future inundations similar to that which it recently experienced. The levee would be 38 ft. above the bed of the river and its total cost would be about $71,000. Plans are being prepared by a commission consisting of the Mayor, Dr. Foster and others, and a special election to vote the necessary tax will probably be held.

The Randolph Bridge.—The new bridge for the Chicago, Milwaukee & St. Paul R. R., over the Missouri river at Randolph point, four miles below Kansas City, has just been completed. We take the following data regarding it from the Kansas City *Times*: The total length of the bridge is 7,392 ft. There are three main spans of 400 ft. each, with trusses 50 ft. high and 23 ft. apart, each with 16 twenty-five foot panels. There is one deck span 160 ft. long, 1,545 ft. of iron viaduct, averaging 51 ft. in height above the ground and 22 ft. wide on top for double track; 2,775 ft. of timber trestle work, from 26 to 47 ft. high, and 1,590 ft. of pile bridge, from 15 to 26 ft. in height.

There are five masonry piers. The four main piers supporting the 400 ft. spans rest upon rock, and the fifth pier rests upon pile fonndation.

The height of the channel piers is 92, 112 and 122 ft. The shore piers are 66 an ! 45 ft. in height. There are 82 pedestal piers 14 ft. in height, resting upon pile foundations. These pedestal piers support the iron viaduct.

In the structure as built there are:

Feet of timber in caissons and cribs	851,091
Feet of timber in timber trestle and pile bridge	849,374
Feet of timber in bridge floor	491,075
Feet of timber in grillage foundations	41,256
Total timber, pine and oak	2,232,796
Lineal feet of oak piles driven	65,634
Pounds of iron and steel in main and deck spans	3,722,645
Pounds of iron in iron viaducts	2,136,915
Pounds of iron rods and bolts in caissons and cribs	144,724
Pounds of iron rods and bolts in timber trestles	35,886
Pounds of iron rods and bolts in floor	30,000
Total iron and steel	6,070,170
Cubic yards of limestone masonry	5,037
Cubic yards of granite masonry	900
Cubic yards of concrete in piers	3,109
Cubic yards of limestone in pedestal piers	990
Total masonry and concrete	9,736

The total weight of Pier No. 3, which is 112 ft. high with its load, is 15,000,000 lbs.

The total weight of the entire structure is 62,550,000 lbs., or 31,275 tons.

The chief engineer of the work was W. D. JENKINS, of the engineering staff of the Chicago, Milwaukee & St. Paul. The contractors for the pier foundations were SOOT SMITH & CO.; for the iron viaduct, M. LASSIG; and for the bridge superstructure, the KEYSTONE BRIDGE CO

New Bridges.—At Northampton, Mass., a bridge is to be built to carry South street over the New Haven & Northampton Railroad. The expense, which will be about $20,000, will be divided between the railroad and the city.——At Woonsocket, R. I., a recent town meeting

refused to rescind the vote of last June, appropriating $6,000 for a bridge across the Blackstone river.—A company has been formed to bridge the Hudson river at Mechanicville, N. Y., with a capital stock of $20,000. Geo. B. Perry is interested.——A bridge will be built over the Northern Central railway near Towsontown, Md., at a cost of $8,000.——A scheme is on foot for bridging the Oconee river at Dublin, Ga.——At Leavenworth, Kan., a scheme is on foot for a highway bridge to cost $500,000. The project, however, is still in an embryo stage.——At Wheeling, W. Va., the project for a bridge across the Ohio river, in connection with a terminal railway line, is taking definite shape. The Chamber of Commerce favors the plan.

Rapid Transit.—*Chicopee, Mass.*—The Chicopee street railway will be built next spring by the Springfield Street Railway Company, of which JOHN OLMSTEAD is President. The line will be about 4 miles in length.

Philadelphia, Pa.—The Metropolitan Underground Railway company has filed with the City Government complete plans and specifications of its proposed lines. JAS. L. LINDSAY is President of the company. If there is a city in this country that needs rapid transit, it is Philadelphia; and we sincerely hope that this, or some similar scheme, may escape being hung up with the red tape of the City Councils, and sometime, in the dim vista of the future, be put into operation.

Omaha, Neb.—Work on the new cable lines is making good progress, and they are expected to be in operation before the holidays.

Kansas City, Mo.—The *Times* states that 28 miles of cable road will be in operation in this city by the end of the present year, and that 21 miles will be built in 1888. This is to make her the second city in the world in cable road mileage, San Francisco leading with 52 miles. This is on the hypothesis, we suppose, that the Kansas City boom continues, and that some other metropolis doesn't catch a similar cable fever.

Denver, Col.—Geo. W. Bowman is to begin work on a system of cable roads at an early date.

California.—At Riverside a 12 mile electric railway is to be constructed. G. O. NEUMAN is Chief Engineer and General Manager of the company.——H. L. Williams has been granted a franchise for a suburban railway at Santa Barbara, 6½ miles long. Any motor but steam may be used.——A cable railway, with suspended overhead cable, is being experimented with at Oakland.

Richmond, (Va.), Electric Railway.—This line is being constructed for the Richmond Union Passenger Railway Company, by T. WILLIAM HARRIS & Co., of New York City. Eleven miles of track have been laid, and poles for the electric wires are being set at the rate of 50 per day. The wires are now being strung and the road will soon be open for business. This road is believed to be the most complicated and elaborate electric railway that has yet been constructed. The system combines a through double track line with steep grades and sharp curves, single track branches, and a loop at one end operated in both directions. We hope to give a complete description of this railway at an early date.

RAILROADS.

East of Chicago.

Existing Roads.—*Intercolonial.*—Tenders are asked for building the Oxford & New Glasgow Railway from Mingo Road to Pictou town, Nova Scotia, by the Dep't. of Railways & Canals, at Ottawa, bids close October 10.

Central Vermont.—Ground has been broken on the extension from Barre to Williamstown, Vt., previously noted.

Rumford Falls & Buckfield.—The survey for the extension of this Maine road from Gilbertville to Rumford Falls, 14½ miles, has been completed.

Boston & Maine.—The New Hampshire legislature is still wrangling over the Hazen and Atherton bills and the final vote is still some distance ahead. The Concord party have recently announced a scheme for a new line from Parker's station, on the Manchester & North Weare line, to Greenfield, about 17 miles. Probably however, the project is only advanced for its effect in the present crisis. The battle in the legislature is a very closely contested one. On the motion to indefinitely postpone the Hazen bill, the vote stood 186 for, to 167 against.

Cincinnati Jackson & Mackinaw.—The line is being extended from Carlisle to Franklin, O., a distance of two miles to connect with the C. C. C. & I.

Turtle Creek Valley.—Grading is nearly completed on this road extending from Stewart's station, a few miles east of Pittsburg, Pa., to Murraysville, about 5 miles. The line will eventually be extended to Saltsburgh on the Western Pennsylvania, a distance of 20 miles. GEO. WESTINGHOUSE Jr., is President of the company.

Lake Shore & Michigan Southern.—The Shenango Valley Railway is not getting along very rapidly. At present both the Pennsylvania and the Erie are fighting it by Court injunctions.

Pennsylvania.—The extension of 5 miles from Frackville to Shenandoah, Pa., is nearly ready for the rails. The line will also be used by the Reading.

New Projects and Surveys.—*Ottawa & Gatineau Valley.*—This Canadian company has recently been reorganized, and the line is now under survey from Ottawa to Desert Village, 100 miles. The section from Ottawa to La Peche, 20 miles, is located and construction will begin upon it at once and will be pushed vigorously till the end of the season. H. J. BEEMER, of Montreal is President and W. D. HARRIS, 14 Metcalf street, Ottawa, is Chief Engineer.

Schenectady & Ogdensburgh.—This New York company has executed a $5,000,000 mortgage to the American Loan and Trust company of New York City. The instrument is signed by JAS. C. JEWETT of New York, Vice-President of the railroad company.

Buffalo & Geneva.—The surveyors on this road are working in Ontario county, N. Y.

Chenango & Cortland.—A company has been formed to take up this abandoned project and complete the line from Cortland to Cincinnatus, 12 miles, within 3 years.

Toledo, Thorntown & St. Louis.—This is another resuscitated project located in Indiana, 42 miles of grading were completed several years ago. The undertaking is now being pushed by JAS. H. CRAWFORD of Lafayette, Ind.

Columbia & Rensselaer.—The company has issued $450,000 worth of bonds and $300,000 worth of stock and will probably begin construction this fall.

Southern.

Existing Roads.—*Elizabethtown & Hodgdenville.*—Grading is progressing on this Kentucky line, 11 miles in length, and it is to be completed by November 1. An extension is contemplated to Scotsville to connect with the Chesapeake & Nashville, but no definite steps have yet been taken. The line is in the interest of the Newport News & Mississippi Valley Company. J. W. ROBINETTE, of Elizabethtown, is Chief Engineer.

Tavares Apopka & Gulf.—Tracklaying is in progress on this Florida road.

Augusta & Chattanooga.—It is stated that grading is to begin work at once on this Georgia road.

Rome & Decatur.—This company became involved in financial difficulty by the failure of GROVESTEEN & PELL of New York City. The bonds of the company among the firm's assets are to be put on the market, and it is rumored that they will be secured by the Richmond Terminal company, who will at once push the road to completion.

Covington & Macon.—This road is also "tied up" by financial difficulties. A. CRAIG PALMER has been appointed Receiver.

Warrior Coal Fields.—It is stated that the Pensacola & Memphis project will be consolidated with this company, who will begin construction on the line at once.

Central R. R., of Georgia.—In reference to the recent issue of $2,500,000 bonds by this company, the Atlanta *Constitution* says: "The bonds are a delicate shade of green, and for 6 per cent. interest."

Tennessee Midland.—Hickman and Cannon counties have each voted $75,000 to aid this road. The proposition to Davidson county to subscribe $500,000 to the company's stock, was defeated, as is more fully noted elsewhere.

New Projects and Surveys.—*Montgomery & Camden.*—A preliminary survey of this projected Alabama line will be made at once.

Ohio & Kentucky.—J. C. STROTHER, of Louisville, Ky., is interested in this projected line extending from a point opposite Madison, Ind., *via* Carrollton and Lexington, to the southern line of Kentucky.

Cartersville, Marysville & Knoxville.—A bill has passed the Georgia legislature incorporating this road.

Louisville, Waynesboro & Alexander.—This company has been incorporated in Georgia.

Cumberland Valley & Eureka.—Application for a charter in South Carolina will be made by this company. The proposed line extends from Walhalla to Charleston.

The Northwest.

Existing Roads.—*Northern Pacific.*—On the Duluth & Manitoba line, which is under construction from Grand Forks, Dak., to the International boundary to connect with the famous Red River Valley line, about 86 miles, grading is completed and tracklaying is nearly finished.

Winnipeg & Hudson Bay.—The 40 mile section of this road which we last week stated to be finished, is to be opened for business at once.

Chicago & Northwestern.—The extension of the Dakota Central line from Faulkton to Gettysburg, 42.75 miles has been completed and opened for business.——Tracklaying is in progress on the Black Hills extension of the Fremont, Elkhorn & Missouri Valley from Rapid City, Dak., to Whitewood creek, 40 miles.

Aberdeen, Bismarck & Northwestern.—Grading is practically finished on this Dakota road, but track will probably not be laid until next season.

St. Paul, Minneapolis & Manitoba.—The Montana extension is making the same rapid progress as heretofore, and the tracklayers expect to reach Great Falls by the middle of October. The tracklaying forces will then go on and lay the iron on the Montana Central from Great Falls to Helena 97 miles, the grade of which has been completed for some time.—Grading on the Willmar & Sioux Falls road is making satisfactory progress.

New Projects and Surveys.—*Mississippi, Fairbault & Northwestern.*—This projected Minnesota line is under survey.

Quincy & Rock Island.—This Illinois project, whose incorporation we noticed two weeks ago, is obtaining right of way along its proposed route, and is reported to be backed by the Rock Island company.

Omaha & Yankton.—A survey of the line is to be made this fall.

Port Arthur, Duluth & Western.—The contract for building the first 40 miles of this road has been let to GRANT & ROSS, and ground has been broken. The grading is to be finished before the close of the season. WALTER SHANLY, of Montreal, is Consulting Engineer.

Duluth Terminal.—The books of the company have been opened for subscription to the stock.

The Southwest.

Existing Roads.—*Kansas City Wyandotte, & Northwestern.*—This Kansas road will cross the Union Pacific at Holton. Reports state that the Fort Scott & Gulf system has an interest in this company.

Central Missouri.—This road has 21 miles graded and 10 miles of track laid. The work has been interrupted from lack of rails but is now again in progress.

San Antonio & Aransas Pass.—Work is progressing on the extension from Yoakum to Flatonia, Tex., and it is to be completed by Nov. 1.

Atchison, Topeka & Santa Fé.—Construction has begun on the extension to St. Joseph, Mo.——It is reported that a project is on foot for extending the Gulf Colorado & Santa Fé from Paris, Tex., to coal mines in Indian Territory.

Chicago Rock Island & Pacific.—A surveying party is reported at work near Wichita Falls, Tex.——The termini of the southern and southwestern extensions are at present Greensburg and Caldwell, Kan.

Missouri Pacific.—The Paola branch, which has been tied up by litigation for a year, will be pushed to completion at once.——The Bald Knob & Memphis line has been opened for business to Wynne, Ark., and will be finished in November.

Kansas City & Southern.—This line which now runs from Osceola to East Lynne, Mo., about 67 miles, is to go on with its Kansas City extension at once. The court injunctions having been removed.

St Louis, Arkansas & Texas.—On the extension from Corsicana to Hillsboro, Tex., about 20 miles of track are now laid. On the Commerce and Fort Worth extension the tracklayers were impeded at Greenville by a force from the Missouri Pacific. The difficulty, however, was amicably adjusted.

New Projects and Surveys.—*Kansas City, Lawrence & Nebraska.*—This company is meeting with good success in obtaining subsidies along the line of its road in Kansas.

Denison & Washita.—The city of Denison, Tex., is interesting itself in this project, and it is reported that a preliminary survey is in progress.

Rocky Mountain and Pacific.

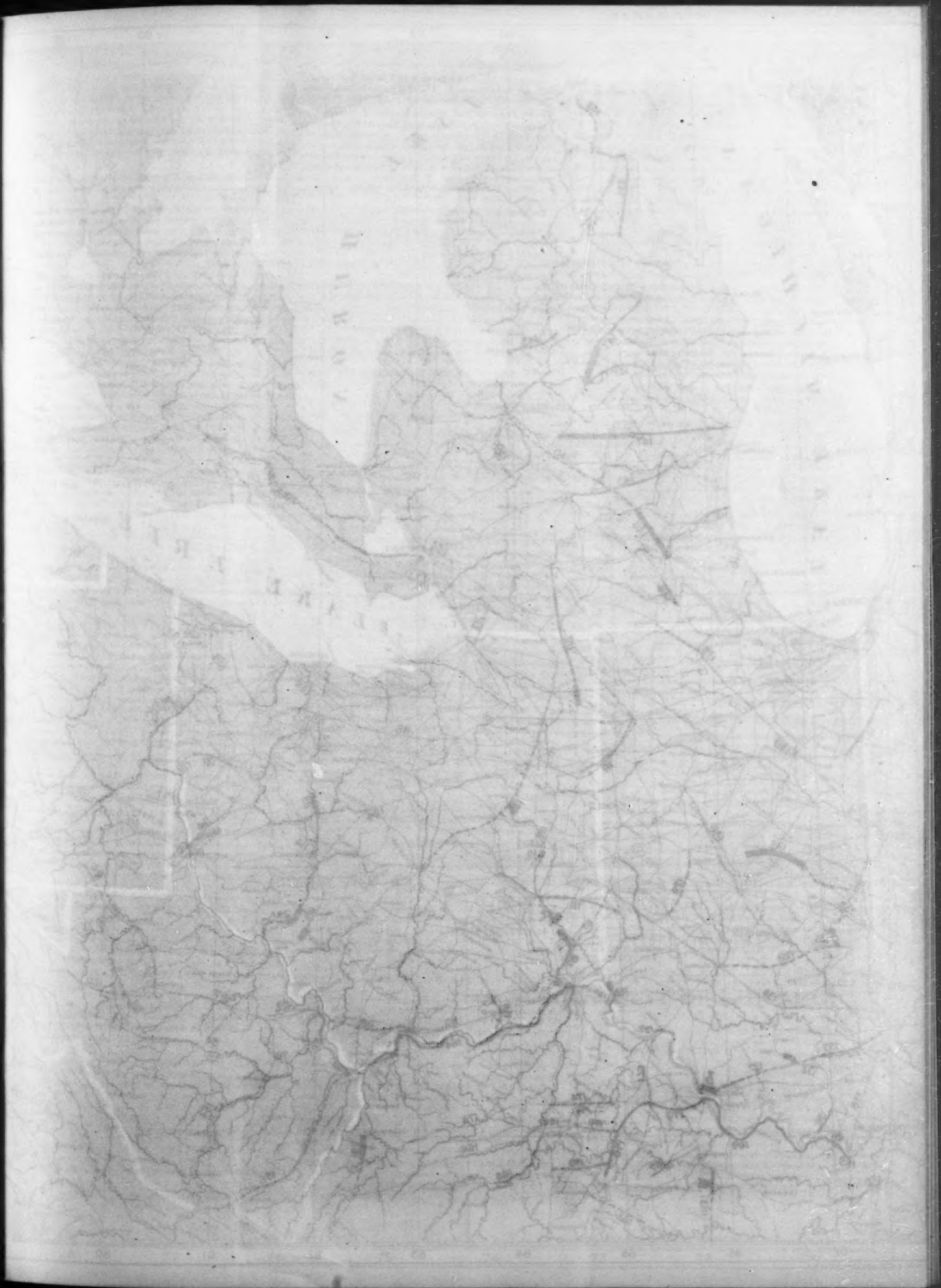
Existing Roads.—*Oregon Railway & Navigation Company.*—Work is at a stand still on the numerous extensions of this company in Oregon & Washington Territory. The managers lay the blame on that well laden scape goat, the Inter-state Commerce Law.

Northern Pacific.—There are still some rumblings after the recent storm, but most of the excitement has subsided. HENRY VILLARD has a scheme for raising 8 or 10 million dollars by an issue of third mortgage bonds, and closing up the affairs of the Oregon & Transcontinental. GREEN & BARBOUR of Helena have the contract for building the Helena, Boulder Valley & Butte line from Boulder to Red Bluff, 40 miles.

Pacific Coast.—Track has been laid from Los Alamos, Cal., south 15 miles on the 40 mile extension to Santa Barbara.

Carson & Colorado.—Rumor states that prominent officials of this road have been making a reconnoisance for the southern extension toward Mojave, Cal.

Denver & Rio Grande.—The tunnel near Glenwood is completed.

New Projects and Surveys.—*San Francisco & San Joaquin Valley.*—This company has filed a charter in California and proposes a railroad from Antioch, Contra Costa county, to a point near Rogers in Kern county, a distance of 280 miles. I. R. WILBUR is interested. This project is of course rumored to be backed by the Santa Fé.

Denver & Golden.—A company has been formed in Denver, Col. to build a railroad to Golden, a distance of 14 miles. I. B. PORTER of Denver is interested. It is stated that the road is to be surveyed and built at once.